VENTILATOR DEPENDENT UNIT DEMONSTRATION

OUTCOME EVALUATION AND ASSESSMENT OF POST ACUTE CARE

Prepared For:

Office of Research and Demonstrations
Health Care Financing Administration

Prepared By:

Lewin-VHI, Inc.

August 15, 1996

REPORTS
RC
735
R48
V46
1996

301233245 8

RC
735
.R48
V46
1996

ACKNOWLEDGEMENTS

The principal authors of this report are David C. Stapleton, Ph.D., who had primary responsibility for the outcome evaluation, and Sally J. Kaplan, Ph.D., who had primary responsible for the post-acute care analysis. Barbara Manard, Ph.D. is Lewin-VHI's Project Director. Alvin Blaustein, M.D., and Mauricio Reinoso, M.D., of the Houston Veteran's Affairs Medical Center and Baylor College of Medicine served as clinical consultants to the project. They replaced Lewin's William Gold, M.D., after his untimely death in 1994. Other current and former Lewin staff who have made substantial contributions to this report include: Nichole Andres; Kyle Bieg; Kimberly Dietrich; Randall Haught; Nyasha Junior; Theresa Mullin; Chris Perrone; Robert J. Rubin, MD.; Purvi Sevak; Nikolai Manilov; Christina Witsberger, Ph.D.; David Zhiang; and Andrea Zueschner.

We are very appreciative of the guidance we have received on this project from Michael Henesch, HCFA's Project Officer, and his colleagues in the Office of Research and Statistics -- especially Mark Wynn. Other HCFA staff made valuable contributions. Our development of the special section of the UCDSS instrument, and collection of the UCDSS data would not have been possible without the help and patience of Mary Pratt and Marian Webb. Mark Krause provided considerable assistance in obtaining the claims data. We are also grateful to LeAnn Weaver and her staff at Fu Associates, Inc., who prepared the UCDSS data files and delivered them to us. Special thanks are also due to Diane Kreimer of the Temple University Hospital Center in Philadelphia, PA, Gary Koenig of the Mayo Clinic in Rochester, MN, Valerie Staley of RMS Health Providers in Hinsdale, IL, and Diane Czlonka of Mt. Sinai Hospital in Detroit, MI, for leading their staffs' efforts to collect clinical data for the Demonstration patients. We are also grateful for the assistance provided to us by the pulmonologists at the Demonstration units: Douglas Gracey, M.D., and Robert Viggiano, M.D. at the Mayo Clinic; Gerald Criner, M.D. at Temple University Hospital; Bohdan Pichurko, M.D. at Mt. Sinai Hospital; Richard Petrak, M.D. at RMS Health Providers. Finally, we thank the many nameless individuals at both the demonstraton units and the Peer Review Organizations in the UCDSS states who toiled for many hours searching through hospital records to extract the clinical data.

CMS Library
C2-07-13
7500 Security Blvd.
Baltimore, Maryland 21244

CHAPTER ONE: INTRODUCTION AND SUMMARY 1-1

I. Introduction 1-1

II. Background 1-1
A. The Need to Address Chronic Ventilator Dependence 1-1
B. Patients Eligible for Admission to a Demonstration VDU 1-3
C. Approach to VDU Care 1-4
D. Reimbursement for the Acute and Post-acute Care of Ventilator Dependent Patients 1-4
E. Reimbursement Methodology for the Demonstration VDUs 1-6

III. Summary of Case Study Findings 1-8

IV. The Outcome Evaluation 1-9
A. Evaluation Questions 1-9
B. Overview of the Outcome Evaluation Methodology 1-10

V. Post-Acute Care 1-11

VI. Summary of Findings 1-12
A. Admissions Analysis 1-12
B. Outcomes Analysis 1-12
C. National Implementation Analysis 1-13
D. Post-Acute Care 1-13

VII. Policy Implications 1-14
A. National Implementation of TEFRA Cost Reimbursement for VDUs 1-14
B. Integration of Care 1-14
C. Monitoring Clinical and Expenditure Outcomes 1-15
D. The Cost Effectiveness of Care 1-16

VIII. Implications for Future Research 1-16
A. Evaluation of Alternative Financing Mechanisms 1-16
B. Collection of Clinical Data 1-16
C. Predicting Outcomes 1-17
D. Post-acute Care and Outcomes 1-17

CHAPTER TWO: LITERATURE REVIEW 2-1

I. Introduction 2-1

II. Literature on Outcomes for Chronically Dependent Ventilator Patients 2-1

III. Post Acute Literature 2-4
A. Characteristics of Chronic Ventilator Patients in Alternative Care Settings 2-4
B. Costs of Caring For Ventilator Dependent Patients in Alternative Settings 2-5
C. Recent Development of Alternative Settings for Ventilator Dependent Patients 2-7
D. Implications From The Two Literature Reviews 2-8

CHAPTER THREE: DATA 3-1

I. Introduction 3-1

II. Demonstration Unit Clinical Data 3-3
A. Collection Methodology 3-3
B. Instrument Design 3-4
C. Strengths and Limitations 3-6

III. Comparison Group Clinical Data 3-6
A. Introduction 3-6
B. Selection of the Comparison Group 3-8
C. Structure of the UCDSS Data 3-8
D. Strengths and Limitations 3-9
E. Comparability of Demonstration and Comparison Group Data 3-9

IV. Medicare Claims Data 3-10
A. Claims Identification 3-10
B. Analysis File 3-11
C. Cost Deflators 3-12
D. Strengths and Limitations 3-12

V. Mortality Data 3-13

CHAPTER FOUR: ADMISSIONS ANALYSIS 4-1

I. Introduction 4-1

II. Methodology 4-1
A. Classificatin of Cases into "Eligibility Groups" 4-1
B. Validation of Eligibility Groups 4-4

III. Findings 4-5
A. Eligibility Groups 4-5
B. Validation 4-6
C. Discussion 4-9

CHAPTER FIVE: OUTCOME ANALYSIS 5-1

I. Methodology 5-1
A. Outcome Measures 5-1
B. Econometric Models 5-3
C. Classification of Cases into Risk Groups 5-8
D. External Risk Variables 5-13
E. Eligibility Variables 5-14

II. Descriptive Statistics 5-17
A. Clinical Outcomes 5-17
B. Expenditures 5-22
C. Descriptive Statistics for Risk and Eligibility Variables 5-26

III. Findings from Multivariate Analyses 5-31
A. Introduction 5-31
B. Differences between Demonstration Units and Comparison Group 5-32
C. Differences among Demonstration Units 5-37

CHAPTER SIX: NATIONAL IMPLEMENTATION ANALYSIS 6-1

I. Introduction 6-1

II. Methodology 6-1
A. Estimation of "At-risk" Cases 6-1
B. Estimation of Additional Medicare Expenditures 6-4

III. Findings 6-4
A. Baseline Estimates 6-4
B. Effects of National Implementation 6-6

IV. Discussion 6-6

CHAPTER SEVEN: PATTERNS OF POST-ACUTE CARE FOR VENTILATOR DEPENDENT PATIENTS 7-1

I. Introduction 7-1

II. Methodology 7-1

III. Brief Descriptions of the Health Care Environment and Patient Characteristics 7-3
A. The Health Care Environment 7-3
B. Patient Characteristics 7-6
C. Weaning Status at Discharge 7-8

IV. Findings For All Patients 7-9
A. Distribution of Service Days Represented by Type of Medicare Part A Claims by Patient Population 7-9
B. Similarities and Differences in the Distribution of Service Days Among Patients 7-11
C. Total and Average Service Episodes for Patients in VDU Units and from the UCDSS Sample 7-12
D. Patients Who Died During the Study Period 7-13

V. Post-Acute Care For Patients Who Survived Their First Time in The Hospital Setting 7-14
A. Post-Acute Service Episodes and Setting Changes for Patients Who Survived Their First Discharge From the Hospital Setting 7-15
B. Hospital Readmissions for Patients Who Survived their First Discharge From the Hospital Setting 7-17

IV. Post-Acute Care Patterns By VDU Unit 7-18
A. Mayo VDU Patients' Patterns of Post-Acute Care 7-18
B. RMS VDU Patients Patterns of Post-Acute Care 7-21
C. Sinai VDU Patients' Post-Acute Patterns of Care 7-23
D. Temple VDU Patients' Post-Acute Patterns of Care 7-23
E. Patterns of Post-Acute Care Across All VDU Units 7-26

V. Patterns of Post-Acute Care for UCDSS Sample Patients 7-27

VI. Discussion 7-32

BIBLIOGRAPHY B-1

CHAPTER ONE

INTRODUCTION AND SUMMARY

I. INTRODUCTION

This report presents the findings from the outcome evaluation and post-acute care analysis of the Ventilator Dependent Unit Payment Demonstration, sponsored by the Health Care Finance Administration (HCFA). The main purpose of the Demonstration is to evaluate the cost and clinical outcomes of treating chronic ventilator-dependent patients in highly specialized rehabilitation units, referred to in this report as Ventilator Dependent Units (VDUs). Under the Demonstration, four existing VDUs were classified as distinct part Prospective Payment System (PPS)-exempt units, reimbursed by Medicare under cost-based payment rules established by the Tax Equity and Fiscal Responsibility Act of 1983 (TEFRA).

The Demonstration VDUs are: 1) the Ventilator-Dependent Unit at the Mayo Clinic, Rochester, MN; 2) the Ventilator Support Center at RMS Health Providers, Hinsdale, IL; 3) the Ventilator Step Down Unit at Temple University, Philadelphia, PA; and 4) the Ventilator-Dependent Unit at Sinai Hospital of Detroit, MI. We have previously reported our findings from case studies of the individual units (Lewin-VHI, 1994).

In the remainder of this chapter we: provide background information (Section II); summarize findings from the case studies that are of relevance to the findings in this report (Section III); discuss the objectives and methodology of the outcome evaluation (Section IV); discuss the objectives and methodology of the post-acute care analysis (Section V); summarize the findings (Section VI); discuss policy implications (Section VII); and discuss implications for future research (Section VIII). In Chapter 2 we update our earlier literature review. The data used for the study are described in Chapter 3. Our analysis of admissions to demonstration units appears in Chapter 4. The methodology and findings from the outcome analysis are presented in Chapter 5. In Chapter 6 we discuss the methodology and findings from our analysis of national implementation of cost reimbursement. We conclude the report with a discussion of our findings from an examination of post-acute care for demonstration and comparison group patients, in Chapter 7.

II. BACKGROUND

A. The Need to Address Chronic Ventilator Dependence

Mechanical ventilation is a very important life-sustaining technology that has grown rapidly in its application in recent years. In fiscal year 1988 nearly four percent of all Medicare inpatient stays included some mechanical ventilation (Lewin-ICF, 1990). Ventilator dependent patients are among the most seriously ill patients in the hospital. Acute respiratory failure frequently occurs in concert with failure of other organ systems or severe chronic diseases. The high cost of care and the high mortality rate seen among ventilator patients (49 percent of

Medicare ventilator cases in FY 1988) reflects the severity of illness and not simply the need for ventilator support.[1]

Despite the typical acuity of their condition, most patients remain ventilator-dependent for only a brief period. For example, the vast majority (as much as 90 percent) of patients can be taken off the ventilator in less than one day. Some patients, however, require ventilation for more extensive periods (i.e., are chronically ventilator dependent) and are generally more difficult to wean from use of the ventilator. Based on analysis of MEDPAR data, in FY 1994 there were over 133 thousand discharges of Medicare patients under the three DRGs most commonly used for long-term ventilator episodes (475, 482, and 483; see Exhibit 1.1). While these discharges constituted just 1.2 percent of all discharges in that year, the mean length of stay for these discharges, 23 days, was much higher than for most other DRGs. The mean length of stay for the DRG that is most commonly used for long-term ventilator dependent patients (483: tracheotomy except for face, mouth & neck diagnoses) was 49 days -- higher than for any other DRG (the next highest mean was 34, for DRG 480: liver transplants) -- and the median length of stay was 39 days.[2]

Exhibit 1.1

Hospital Discharges and Length-of-Stay in Three DRGs used for Chronic Ventilator Patients, Fiscal Year 1994

DRG	Standard Payment	Number of Discharges	Mean LOS	LOS Percentile				
				10th	25th	50th	75th	90th
475	$13,830	89,293	12.9	2	6	10	17	25
482	$13,683	7,250	16.2	5	8	12	19	30
483	$60,189	36,919	49.3	16	25	39	60	91
Total		133,462	23.1	n.a.	n.a.	n.a.	n.a.	n.a.

n.a.: not available
475: Respiratory system diagnosis with ventilator support
482: Tracheotomy for face, mouth & neck diagnoses
483: Tracheotomy except for face, mouth & neck diagnoses
Sources: The standard payment is the FY1994 national payment standard for urban areas (*Federal Register,* Vol. 58, no. 168, September 1, 1993, p. 46362) times the DRG weight. The DRG weight, discharges, and length of stay are from *Federal Register*, Vol. 60, No. 170, September 1, 1995.

The typically high acuity of chronic ventilator dependent patients requires relatively resource intensive, expensive care for long periods. The total share of costs for care of the chronically ventilator dependent patient is therefore disproportionately high. This is reflected in

---

[1] See Lewin-ICF (1990).

[2] See *Federal Register*, Vol. 60, No. 170, September 1, 1995.

the DRG weight for DRG 483, which was 16.1 in FY 1994 -- second behind the weight of 16.3 for liver transplants and substantially above the third highest weight of 13.8 for heart transplants (103). Based on HCFA's FY 1994 standard payment for these DRGs, total expenditures for discharges in FY1994 in the three DRGs was on the order of 3.5 billion dollars -- 2.2 billion dollars in DRG 483 alone.[3]

The type of care provided in the Demonstration VDUs offers the promise of increased weaning rates, reduced acuity and increased longevity for patients classified as chronically ventilator dependent. Daily hospital care is likely to be less expensive for demonstration patients because VDU care usually replaces care that would be provided in more expensive intensive care units (ICUs). Expenditures for the entire hospital stay and in the post-hospital period may nonetheless be higher because of greater longevity for VDU patients, but increased longevity may justify an expenditure increase, especially if the quality of life for patients who survive longer is reasonably good.

B. Patients Eligible for Admission to a Demonstration VDU

HCFA established VDU admission criteria in order to insure that the VDUs only admitted patients who could benefit from the type of care that the VDUs were designed to provide (see Section II.C). The basic criteria were:

1. Patients must be ventilator dependent for at least one part of the day (six hours or more) at the time of admission to the ventilator unit.
2. Patients must have been ventilator dependent for at least 21 days during the current hospitalization prior to their admission, and in general, there must have been at least two unsuccessful attempts to wean the patient prior to admission to the rehabilitation unit. Exceptions to both these criteria could be made for patients who were considered unweanable but who needed home ventilator training and would otherwise have been eligible.
3. Patients must have been breathing through a tracheotomy tube, have had an endotracheal tube in place with imminent plans for tracheotomy, or have both been undergoing non-invasive ventilation and met certain established clinical and physiological criteria.
4. Patients had to be clinically and physiologically stable enough to benefit from the rehabilitation services of the unit. This included respiratory stability while on ventilation, hemodynamic stability, and medical stability with respect to renal status, absence of sepsis and gastrointestinal bleeding (and stable hemoglobin and hematocrit), and metabolic (endocrine system) problems.
5. There must have been reasonable expectation that the patient could be weaned or discharged from the hospital to a less acute setting, such as a rehabilitation facility, skilled nursing facility or home. [4]

---

[3] The total expenditure figures include beneficiary payments and payments made by insurers other than Medicare. We have not made any adjustments for: discharges from non-urban hospitals, which are paid at lower rates; beneficiary exhaustion of annual and lifetime limits on inpatient days, which would reduce the estimate; or outlier payments, which would increase the estimate.

[4] The detailed admission criteria appear in the appendix.

Only one of the VDUs, Temple, admitted a significant number of patients who were using non-invasive ventilation. Although we have obtained data on these cases, we did not use them in the outcome evaluation because their care was fundamentally different than the care provided to patients using invasive ventilation and because we did not have comparison group data for non-invasive cases.

C. Approach to VDU Care

Patients who have been ventilator dependent for long periods and, in particular, who have severe underlying respiratory, neuromuscular or neurological disease, or are severely debilitated by their illness may need to first improve their respiratory muscle function and nutritional status in order to wean successfully. As this implies, patients who are chronically ventilator dependent represent a fairly heterogeneous population that can present a wide variety of challenges to the process of rehabilitation.

To address all of the dimensions of these patients' needs in the process of weaning, the approach used by each of the four Demonstration units included the use of a multidisciplinary team of care-givers with a rehabilitative focus. Staffing typically included pulmonologists, nurses with advanced training in respiratory care, respiratory therapists, occupational, physical and speech therapists, dietitians and psychologists, and social workers.

D. Reimbursement for the Acute and Post-acute Care of Ventilator Dependent Patients

As enacted in 1965 under Title XVIII of the Social Security Act, Medicare was designed to provide acute care services to eligible beneficiaries. Medicare includes Hospital Insurance (Part A) and Supplementary Medical Insurance (Part B). Those eligible for Medicare include persons aged 65 and over eligible for Social Security benefits, persons under age 65 receiving Social Security Disability Insurance for two years; persons with end-stage renal disease; and persons aged 65 or older who are not otherwise eligible but enroll by paying a monthly premium ($261 in 1995).

Medicare Part A reimburses inpatient hospital care up to a maximum of 150 days in a single spell of illness. The first 60 days of hospitalization are fully paid by Medicare less a deductible ($716 in 1995). For days 61-90, the beneficiary pays a daily copayment ($179 in 1995). After 90 days, the beneficiary can use a 60-day "lifetime reserve" with a daily copayment ($358 in 1995). Many chronic ventilator dependent patients require inpatient care that extends beyond the 150 day limit, and the deductibles and copayments add up to significant personal expenses for those who do not have supplemental insurance (e.g., Medigap). When supplemental insurance for Medicare beneficiaries covers SNF care and at-home recovery[5] these policies use the same "skilled care" requirements as Medicare.

---

[5] There are 10 standard Medigap policies; eight of the 10 cover SNF co-insurance and two of the eight cover at-home recovery (Fox, Rice, & Alecxih, 1995).

Medicare's Prospective Payment System (PPS) pays acute care hospitals on a prospective basis. A fixed payment amount is paid to the hospital for each admission after the service episode, according to the patient's diagnosis. Hospitals are reimbursed for ventilator patients under Medicare Part A under DRGs 482 and 483 for patients mechanically ventilated with a tracheotomy and DRG 475 for other patients mechanically ventilated. This payment system provides hospitals with strong incentives to discharge Medicare patients as soon as clinically appropriate. This system has led to increased demand for post-acute care services for higher acuity patients such as ventilator patients.

Medicare exempts some providers from PPS. These providers include rehabilitation hospitals and units, long-term hospitals, psychiatric hospitals, children's hospitals, and other specialty hospitals and units. Medicare reimburses these PPS-exempt facilities on a facility-specific, cost-related basis (per discharge) under rules established in the Tax Equity and Fiscal Responsibility Act (TEFRA) of 1982. Some of these PPS-exempt facilities provide specialty care for ventilator patients, and several corporations have acquired large numbers of long-term care hospitals and nursing homes for this purpose.

Medicare payment and coverage policies, including reimbursement of therapies and allocation methods for administrative and other costs, contain strong incentives for nursing homes providing traditional long-term care services to offer more skilled care. Ventilator dependent patients are among those who require a higher level of care. SNFs can also apply for "atypical services exceptions" to obtain higher reimbursement for ventilator dependent patients. Freestanding and hospital-based SNFs may apply for an exception to their routine cost limits for one of four reasons. Exceptions may be granted to SNFs providing "atypical services," for extraordinary circumstances (e.g., natural disasters), unusually high labor costs, and provision of care to areas with fluctuating populations. The most common type of exception request is for providing "atypical services." Atypical care includes patients with high nursing and rehabilitation care needs, patients with more serious illness, a high proportion of Medicare utilization, and patients with very short LOS.

Medicare Part A provides skilled nursing care or rehabilitation associated with recuperation in a skilled nursing facility for up to 100 days following a hospitalization (daily copayment for days 21-100 at $89.50 in 1995). However, chronic ventilator patients often exceed the 100 SNF days allowable under Medicare Part A.

When a patient's Medicare SNF benefit is exhausted, state specific Medicaid reimbursement policies become important. In states where Medicaid reimbursement is low or where eligibility standards are high, SNFs have disincentives to accept ventilator patients who are at risk of staying beyond their Medicare eligibility. A handful of states (e.g., California and

Maryland) have instituted small programs specifically for "subacute patients," which includes most ventilator dependent patients.[6]

Approximately 20 states, however, have some form of Medicaid case-mix reimbursement that in theory pays the additional cost of caring for ventilator dependent patients. For example, the widely-used RUGS III nursing facility case-mix classification system has a special class that includes patients on a ventilator. In some states (e.g., Texas), there has been considerable controversy over whether or not the state's Medicaid case-mix payment system provides sufficient reimbursement to pay for ventilator dependent patients. Various state-specific approaches have developed. Nebraska, for example, uses a RUGS-based case-mix reimbursement system, but "carves out" ventilator patient reimbursement, for which it essentially pays a negotiated rate.

Home care is a preferred alternative to institutionalization for many ventilator dependent patients. Medicare does not have copayments, deductibles, or limits on days of eligibility on home care reimbursement for a range of services needed by ventilator patients, including nursing and therapy care. However, Medicare pays only 80 percent of reasonable charges for durable medical equipment (DME) such as a ventilator. The remaining 20 percent can be a financial burden for many patients.

E. Reimbursement Methodology for the Demonstration VDUs

Prior to the start of the VDU Demonstration, numerous studies found that payments for chronic ventilator patients were well below hospital costs.[7] In the aggregate, hospital losses for these patients were offset, at least partially, through payments for patients with below-average costs. Nonetheless, the payment system in place at the time resulted in both inequities in the distribution of payments across hospitals and incentives to avoid attracting and caring for chronic ventilator patients.

HCFA addressed these concerns in two ways. First, the DRG system was revised in October of 1990 so that most long-term ventilator patients would be grouped together. Prior to that date, many were classified in DRGs that included many lower cost patients who did not require ventilator use. In the revised system, most such cases were regrouped with other high-cost ventilator cases, regardless of diagnoses, thereby reducing within DRG cost variation.[8]

---

[6] The State of California, for example, instituted a subacute classification of care in 1986. The use of the term, "subacute care" varies greatly among providers, but California has defined subacute level of care as "a level of care needed by a patient who does not require hospital acute care but who requires more intensive licensed skilled nursing care than is provided to the majority of patients in a skilled nursing facility". The minimal medical standards of necessity for subacute care require that the patient is technology dependent and requires ready access to acute hospital services and 24-hour nursing care from a registered nurse. The typical patient appears to have a tracheotomy and requires either ventilation or suctioning and oxygen. See *California Register*, Vol. 42, October 21, 1994.

[7] These studies are reviewed in Lewin-ICF (1990).

[8] See *Federal Register*, Vol. 55, No. 90, May 9, 1990, pp. 19430-1.

Second, HCFA developed and implemented the VDU Demonstration for the purpose of evaluating the effect of replacing PPS payments for these cases with cost reimbursement payments under the TEFRA rules.

The cost reimbursement methodology seeks to reimburse VDUs for actual costs, on average, but includes incentives to control costs. A "ceiling" cost per-case was established on the basis of the unit's experience and expected patient flow. If cost per case in a reporting period was below the ceiling, the unit was reimbursed for all cost plus the lower of 50 percent of the difference between the ceiling and actual cost, or five percent of the ceiling. If cost per case exceeded the ceiling, the unit was reimbursed for the ceiling plus 50 percent of the excess cost. The ceiling was increased each year by the Medicare update factor for the hospital.[9]

Under PPS, the VDU hospitals would not receive any reimbursement for VDU care beyond the DRG payment unless the patient's length of stay exceeded the outlier threshold for the DRG. For DRG 483, the threshold was 67 days in FY1994 and the standard daily payment for outliers was $733, which is several hundred dollars below the estimates of the average daily cost of care in the VDUs and on the order of one thousand dollars less than the average daily cost of ICU care(see Section III).[10] Outlier payments for other DRGs were lower. Thus, under the revised DRG system there is a very strong financial incentive to discharge chronic ventilator patients even after they reach their DRG threshold.

The financial incentive to discharge a patient becomes even stronger if the patient is hospitalized long enough to hit the 90-day Medicare limit plus any days left in their 60-day lifetime reserve. This limit applies under both TEFRA reimbursement and PPS. In-patient benefits are restored once the patient has been out of both the hospital and skilled nursing facilities (SNFs) for 60 days. We found a number of cases in both our comparison and Demonstration groups that had reached their limit. In some cases this occurred during re-hospitalizations before the 60-day requirement for restoration of benefits had been satisfied.

Beneficiaries themselves have a financial incentive to be discharged once they have been hospitalized for 60 days. Up until that point, they pay only the Part A deductible ($696 in 1994), but copayments after the first 60 days of hospitalization are substantial, especially after 90 days (in 1994 these were $174 for days 61 through 90 and $348 for days 91 through exhaustion of the lifetime reserve), and may not be collectable if the patient is not adequately insured. Thus, even under TEFRA reimbursement there remains a strong financial incentive to discharge patients whose hospital stays are exceptionally long.

---

[9] See *Federal Register*, Vol. 58, No. 168, September 1, 1993, p. 46362.

[10] The daily outlier payment is 60 percent of the DRG payment divided by the mean length of stay.

III. SUMMARY OF CASE STUDY FINDINGS

For the case studies, we obtained information on staffing patterns and the process of care through review of documents and a series of intensive interviews with a cross-section of staff (see Lewin-VHI, 1994). The latter were conducted using formal interview guides during two-day site visits to each unit. We also analyzed cost information obtained from the financial departments of the VDU hospitals.

The main findings of the case studies, all of which are relevant to the outcome evaluation or post-acute analyses, are:

- *Efforts to identify potential candidates for admission and the admissions screening criteria used varied substantially across the four Demonstration units.* Several factors influenced these differences, including: variations in institutional setting and the degree to which the host institution offered a built-in referral pool of good candidates; the size of the VDU and, thus, the size of internal demand for beds to be filled to cover unit costs; the range of discharge options available to patients leaving the VDU and the extent to which a limited range serves as a constraint on accepting patients with less than good prospects for returning home and being weaned from the ventilator. The Mayo and Temple VDUs, both with a rather large in-house referral pool, moderate sized units (6 and 12 beds respectively) and limited discharge options for most patients, tended to be more selective in patient admissions. Patients accepted into these units may have a high level of acuity when admitted to the unit, but they are generally judged to have good longer term prospects for being weaned and returning home.

- *Approaches to staffing and patient care management differed across the four Demonstration units.* The Mayo and Temple VDUs made intensive use of a relatively small, but very highly trained and high cost staff (e.g., staff pulmonologists, residents, registered nurses) while the RMS unit worked with a larger number of contracted staff and used relatively greater numbers of skilled but lower cost therapeutic staff. Similar overall approaches to patient care management were taken in all of the units. This included weekly multidisciplinary team meetings to discuss each patient being cared for in the unit, and daily bedside rounds generally made by the attending pulmonologist, primary nurse and respiratory therapist. In the Mayo and Temple units, there was a greater identification of the Medical Director as playing a heavily involved "leadership" role. The Medical Directors in the other units were not viewed as playing a similarly predominant role.

- *In addition to the distinctively rehabilitative focus of the four units, each had a strong discharge-orientation that appears to serve rather effectively in minimizing patient length of stay in the units.* Because discharge options vary significantly by location of the VDU, the discharge provided by each similarly varies substantially. While all of the activities involved in patients' care within the VDU might be characterized as "discharge preparation", the discharge process is the logical continuation of the rehabilitation process carried on in the units that bring patients to the best possible functional status at the time of discharge. Under the best circumstances, the discharge preparation process provides patients and their families with knowledge and capability to maintain that level of ability.

- *The daily cost of care for in VDUs is considerably lower than that for comparable patients in ICUs.* Daily cost estimates for VDU care ranged from $958 at RMS to $2,064 at Sinai. The Sinai figure was extraordinarily high because of fixed costs and the very low volume of cases that had been through the unit at the time. The estimate for Temple was much

closer to that of RMS, $1,191, and the estimate for Mayo was one dollar more. ICU cost estimates ranged from $1,678 at Temple to $1,865 at Mayo.[11] Thus, the daily cost of care in the VDUs appears to cost from $500 to $700 dollars less than ICU cost for comparable patients.

The first of these findings leads us to expect better clinical outcomes for the Temple and Mayo cases on the basis of screening alone, so it is critical to assess and control for differences in screening when analyzing outcomes. It will also be interesting to see whether the different approaches to staffing and leadership have an impact on clinical and expenditure outcomes, and whether the variation in approaches to discharge planning and the availability of discharge options results in different patterns of post-acute care. The last finding is supportive of the claim that VDU care lowers the cost of care, but a full assessment of that claim requires an analysis of the impact on length-of-stay and post acute care.

IV. THE OUTCOME EVALUATION

A. Evaluation Questions

The main purpose of the Demonstration was to determine whether treating chronic ventilator-dependent patients in highly specialized ventilator rehabilitation units will result in high quality clinical outcomes at a reasonable cost. Although the findings from the case studies were encouraging in this respect, the information obtained was largely qualitative and could not, by its nature, reach a definitive conclusion on this point. The outcome evaluation was designed for that purpose.

The outcome evaluation addresses each of the following specific questions:

- *How selective were the Demonstration units in admitting suitable patients?* The VDUs were designed to provide rehabilitative care. As discussed in Section II, the VDUs were required to impose admission criteria which were intended to prevent the admission of patients for whom rehabilitative care was not suitable. Hospitals that are being paid for Medicare patients under PPS have a strong incentive to admit long-term ventilator patients into TEFRA-reimbursed units, so screening out patients with little rehabilitation potential is critical to controlling Medicare expenditures;
- *What were the effects of the Demonstration on clinical outcomes?* The clinical outcomes of interest are mortality, duration of the ventilator episode, amount of ventilator use at discharge, length of hospital stay, functional status at hospital discharge, and destination at hospital discharge.
- *What were the effects of the Demonstration on Medicare and other expenditures?* The most common approach to examining expenditures for ventilator care is to focus on expenditures during the hospital stay. While such information is useful, we would also like to know how VDU care affects expenditures after discharge. The direction of the effect of

[11] We did not obtain a reliable estimate of ICU costs for RMS because almost all RMS VDU patients were transferred from other hospitals. The value for Sinai was $1,843.

the Demonstration on post-discharge expenditures is ambiguous in theory, even assuming that the Demonstration has positive effects on the health of patients. Increases in expenditures that are due to increases in longevity may more than offset any savings that accrue due to improvements in health.

- *What would the cost of national implementation be?* We estimate the cost to Medicare of implementing TEFRA-reimbursement for VDU care nationally under the same admission criteria that are used in the Demonstration.

B. Overview of the Outcome Evaluation Methodology

The outcome evaluation has three parts: admission analysis, outcome analysis, and national implementation analysis. All three of these analyses rely on clinical and claims data collected for Demonstration patients and a comparison group. Data for the comparison group patients were collected from hospital records for patients that were identified from Part A discharge claims, using HCFA's experimental Uniform Clinical Data Set System (UCDSS).

For the *admissions analysis*, we sought to determine which VDU and UCDSS patients satisfied the VDU admission criteria. Exact determinations were not possible, both because the information we had available for making the determinations was much less complete than would be available to a clinician from a VDU and because the determination, to some extent, relies on subjective judgment. Instead, we examined specific clinical measures of each patient's condition on or around "Day 21" of the ventilator episode -- the first day of the ventilator episode on which most patients could be eligible for VDU care according to the criteria -- and classified them into four "eligibility groups" according to the extent to which the information examined supported the hypothesis that they satisfied the admission criteria. We also had our clinician consultants examine more extensive clinical information on a random sample of 100 cases (15 from each VDU plus 40 UCDSS) and make a clinical judgment about the medical stability and rehabilitation potential of each case on or around Day 21. We then compared the findings across the VDU and comparison groups.

For the *outcome analysis*, we estimated multivariate models for hospital length-of-stay, weaning, mortality, functional status, and expenditure models. These models control for differences in risk among patients, as well as for the fact that VDU cases were screened for admission, whereas UCDSS cases were not.

With the exception of mortality, clinical outcomes are measured only at discharge; we were able to determine post-discharge mortality for most patients who were alive at discharge through September of 1995. For the expenditure analysis, we examine expenditures during the full hospital stay (including the VDU stay for Demonstration cases) and for the 18-month period that begins on the date of hospital admission. The longer, fixed-length period is examined in order to more fully capture the impact of the VDUs on expenditures, including post-discharge expenditures; we would have examined expenditures for a longer period if enough time had elapsed to observe it.

For the *national implementation analysis*, we used findings from the admissions and outcome analyses along with tabulations from HCFA's 1993 MEDPAR file to estimate the cost of implementing the Demonstration's cost-reimbursement methodology nationwide for all patients satisfying the VDU admission criteria.

V. POST-ACUTE CARE

The objective of the post-acute care segment of the ventilator study is:

- To examine patterns of post-acute care for chronic ventilator dependent patients.[12]

Little is known about post-acute patterns of care for ventilator dependent patients. In fact, to our knowledge this is the first study of post-acute care of its kind. The literature does indicate that there has been increasing pressure on acute hospitals to transfer ventilator dependent patients to lower cost alternative settings. The literature also indicates that the number of places available in alternative settings capable of providing care to ventilator patients has increased. Frequently these post-acute programs are called "subacute" programs or units[13]. However, we do not know what happens to ventilator dependent patients post-hospital. The post-acute segment of this study provides a preliminary examination of ventilator dependent patients' post-acute care.

The post-acute segment of this study describes the patterns of post-acute care for the patients discharged from the VDU, or from the hospital in the case of patients from the UCDSS sample. The methodology used allows us to examine post-acute care patterns by VDU patients and to descriptively compare VDU post-acute patterns to post-acute care patterns for a large sample of chronic ventilator dependent patients (i.e., patients from the UCDSS sample).[14] More specifically, we examined Medicare Part A claims for the acute and post-acute service episodes for all patients for whom we had claims data to determine if there were patterns of post-acute care. The patients were followed through claims for as long as 18 months from their initial hospital admission.

---

[12] We use the term ventilator dependent to describe patients who currently are or who at one time in this study were ventilator dependent. In this study virtually all of the patients are considered to be chronically ventilator dependent, having been ventilated for 21 or more days, as discussed above.

[13] A recent study of subacute care for the Department of Health and Human Services, Office of the Assistant Secretary for Planning and Evaluation, found that the term of subacute care had two definitions (Lewin-VHI, 1995). First, the term "subacute care" is increasingly used to describe higher acuity patients, typically patients with complex needs who require skilled care (i.e., "high-end" skilled Medicare patients). Second, the term is also being used to describe a new and developing type of care that has several key elements, including: being an organized program intensely focused on achieving specified, measurable outcomes; using special physical plant and/or professional resources; and using a set of techniques thought essential to achieve stated goals.

[14] The UCDSS sample is a selective sample chosen over a few months from patients with DRG 483 who were on a ventilator for 20 or more days in the five states in which the UCDSS was piloted.

VI. SUMMARY OF FINDINGS

A. Admissions Analysis

The following are the main findings from our admissions analysis. The findings from the grouping of cases according to evidence of eligibility and our examination of violations of specific admission criteria were consistent with those from the clinical reviews of sample cases.

- The VDU cases, as a whole, had substantially stronger evidence of eligibility than the UCDSS cases;
- many instances of apparent violations of the VDU admission criteria were found among VDU cases, as well as among UCDSS cases; and
- Compliance with the criteria appears to have been greatest at the Mayo VDU; the degree of compliance at the other VDUs was evidently lower, but there were no clear distinctions among the three.

Based on the clinical review of sample cases, we estimate that from two-thirds to 80 percent of UCDSS cases would have been admitted to a VDU had their cases been considered for admission.

These findings are discussed in greater detail in Chapter 4.

B. Outcomes Analysis

1. Clinical Outcomes

The main findings from the analysis of clinical outcomes, after adjusting for differences in eligibility and risk to the extent it was feasible to do so, are the following:

- Overall, VDU clinical outcomes were substantially better than those for UCDSS cases. VDU cases had significantly lower hospital mortality and significantly higher weaning rates. Those who were alive at discharge lived much longer, were more likely to be discharged to home, were more likely to be cared for by themselves or a family member, and had better scores on a functional status index;
- While VDU clinical outcomes were generally better than those for UCDSS cases, this finding was not true for all VDUs. Outcomes for Mayo and Temple cases are clearly better than those for UCDSS cases, but outcomes for Sinai and RMS cases are not.

2. Expenditures

The following are the main findings from the analysis of expenditures, after adjusting for risk and eligibility factors.

- Mean Medicare and total expenditures for UCDSS cases were very high. The mean hospital stay cost Medicare $91,000 (1994 dollars), and mean total expenditures (including beneficiary and other insurer payments) were $99,000. Expenditures for the 18 month period beginning with hospital admission are about 20 percent higher.
- Mean Medicare and total expenditures for the VDU cases during their hospital stay was substantially higher than for the UCDSS cases, but this was largely due to the longer lengths of stay for VDU patients. Expenditures per inpatient day for VDU cases were lower than for UCDSS cases.
- Mean Medicare and total expenditures for the VDU cases during the 18 months following hospital admission were also substantially higher than for UCDSS cases, but this was due to their greater longevity. Expenditures per day alive were much lower during this full period.
- Expenditures varied substantially across the four VDUs. The adjusted means for Mayo and Temple cases were the lowest. The adjusted means for RMS cases were the highest -- about 75 percent above the Part A means for UCDSS cases, and about 30 percent above the Part B means.

These findings are discussed in greater detail in Chapter 5.

C. National Implementation Analysis

We find that national implementation with effective controls on admission and following the Temple model would have increased Medicare expenditures in 1994 by about $0.4 billion, while implementation with ineffective controls on admission and following the RMS model would have increased Medicare expenditures by about $1.25 billion. While the increased expenditures in the low expenditure scenario might be justified by the relatively favorable outcomes found for the Temple cases, the outcomes for RMS cases were not demonstrably better than those for UCDSS cases.

These findings are discussed in greater detail in Chapter 6.

D. Post-Acute Care

In our analysis of Part A claims for the 18-month period beginning with hospital admission, we found that:

- Virtually all ventilator dependent patients discharged alive from the VDU or acute hospital (in the case of patients from the UCDSS sample) use post-acute care, regardless of ventilator status at discharge.
- Most ventilator dependent patients using post-acute care use multiple settings. (One patient had 24 changes in settings during an 18 month study period.)
- Most ventilator dependent patients have at least one acute re-hospitalization and some patients have multiple re-hospitalizations.

These findings are discussed in greater detail in Chapter 7.

VII. POLICY IMPLICATIONS

A. National Implementation of TEFRA Cost Reimbursement for VDUs

The findings from this study provide little support for national implementation of TEFRA cost-reimbursement for VDU-type rehabilitation units. Given our admission findings, it is unlikely that effective means can be found for limiting admission to patients who will benefit from this type of care. Further, given our outcome findings, it is likely that Medicare and total expenditures for patients treated in many new units would be much higher than under PPS and that they would benefit little from that care.

One option worth considering is establishment of a small number of "Centers of Excellence" for the care of chronically dependent ventilator patients, modeled after the Mayo and Temple VDUs. These two units have clearly demonstrated an ability to improve the outcomes for such patients. Such centers would serve two purposes:

- They would improve access to the high quality of care that such units can provide; and
- They would promote the development of better methods for treating chronically dependent ventilator patients.

As found in the case studies, a key feature of both the Mayo and Temple units is that they have strong leadership by highly regarded pulmonologists who are dedicated to a mission of improving the care for such patients.

B. Integration of Care

Chronically dependent ventilator patients require a wide variety of health care services over a long period of time. For both clinical and economic efficiency reasons, it is important that the financing of that care should promote the use of the most cost-effective services for each patient. Current mechanism's do not; they instead create incentives to move such patients from one setting to another. What is needed is a financing mechanism that promotes the integration of care.

Managed care is one approach to achieving the integration of care. Under managed care, a single entity, the patient's health plan, is financially responsible for all aspects of a patient's care, and use of the most cost-effective care would be in this entity's financial interest. If, for instance, early discharges from an initial hospitalization led to costly hospital readmissions, health plans would be able to spot such patterns and alter treatment protocols. This, in fact, is the upside promise of managed care for chronically ill patients. As a practical

matter, however, the severely ill ventilator-dependent patients included in this study are among those least likely to choose managed care plans and those whose high costs make them unattractive to health plans, given the limitations of currently available risk-adjustment methods.

Another way to finance the care of these patients would be to contract with health plans to provide case management services. This is relatively common in the world of private health plans for cases that are medically complex and relatively rare, such as those of chronic ventilator patients. Under optimal conditions, such plans assign a nurse case-manager to follow and work with certain at-risk high cost patients from the perspective of the payor and patient. This case-manager can counter setting-specific financial incentives and make special arrangements (e.g., for extra home care services) when that will be cost-effective (e.g., prevent a re-hospitalization) in terms of the entire episode of care. Medicare may want to consider such an option for the types of patients included in this study.[15]

C. Monitoring Clinical and Expenditure Outcomes

The complexity and cost of care for chronically dependent ventilator patients makes these patients especially vulnerable to problems and changes in the health care delivery system. Changes in health care financing or other aspects of the health care system have the potential for disrupting the care of these patients and/or imposing an enormous financial burden on Medicare and other payers. The introduction of PPS is an example of such a change; this demonstration emerged from a recognition that the DRG system as originally implemented was unsatisfactory for these patients. As discussed above, the current push to increase the enrollment of Medicare beneficiaries into managed care also increases the potential for drastically altering the care of these patients. Given these facts, it would be prudent to establish a system for monitoring the care and expenditures of these patients, perhaps through administrative databases.

We have found that it is possible to learn a lot about these patients through the use of Medicare claims data alone, and under the current system these data might suffice for monitoring purposes. This is likely to change as managed care enrollment increases. Collecting and monitoring clinical data on these cases might also be worthwhile, through the development of a special instrument under the Medicare Quality Indicator System (MQIS) for reviewing hospital care. Collection of clinical data outside of the hospital setting might also be warranted because these patients are high users of health care services and frequently move from one site of care to another.

---

[15] To illustrate the economics of case management, one large plan assigns a nurse case-manager to certain high-risk, high cost patients. These nurse-managers have a case load of approximately 50 patients. Assume that each nurse-manager costs as much as $125,000 per year (salary, benefits, plus program administration). With a case-load of 50 patients, each nurse-manager needs to show a net per-patient savings of only $2,500 ($125,000 ÷ 50) to make the program cost-effective.

D. The Cost Effectiveness of Care

In a world where resources for health care are scarce, it is necessary to consider the difficult question of whether the resources devoted to the care of chronically dependent ventilator patients should be allocated to some other use. Can the very high expenditures for these cases (an average of $99,000 for the hospital care of UCDSS sample patients) be justified given the scarcity of health care resources and the poor clinical outcomes (48 percent in-hospital mortality and, for survivors, a high level of dependence on others, plus continuing high expenditures) for those who survive? While it would be wrong to limit the care of a whole class of patients to services that would ease their dying, unrestrained efforts to prolong their lives can be both inhumane and economically wasteful.

As economic and political pressure to control the growth of health care spending continue to increase, a more intense scrutiny will be given to the appropriateness of care for high cost patients with poor prospects for survival or a high quality of life. Chronically dependent ventilator patients will obviously be one target of that scrutiny, as they already are. A better understanding of the cost-effectiveness of the care for these patients is critical to decision makers -- politicians, administrators, physicians, families, and the beneficiaries themselves -- who are faced with making tough choices on these issues.

VIII. Implications for Future Research

A. Evaluation of Alternative Financing Mechanisms

As discussed in the previous section, there is a need for the development of financing mechanisms that promote the integration of care for chronically dependent ventilator patients. It would be very worthwhile to study the care of such patients under alternative mechanisms, include managed care and case management. There may be low cost opportunities to perform such studies in conjunction with existing or past demonstrations, or even through collection of data on Medicare beneficiaries who are enrolled in managed care. HCFA may want to consider a demonstration to test the use of case management services.

B. Collection of Clinical Data

As discussed in Chapter 3, we understand that HCFA has abandoned the UCDSS project and is instead developing special instruments for collecting hospital data on specific types of cases for the purposes of PRO review under the MQIS. The difficulties we have encountered in using the UCDSS data suggest that this is a better strategy, at least for ventilator patients. The UCDSS instrument section developed for this project and the instruments developed for the collection of VDU data provide a useful starting point. One of our consulting clinicians has adapted the VDU instruments for the collection of data on his own ventilator cases.

We have learned a lot from the data collected for this study, despite its many problems. We believe that much more could be learned from collecting higher quality information on more cases. Collection of data for the primary purpose of PRO review would serve a very important research purpose as well, and, along with claims data, could also provide the foundation for a monitoring system (see above).

C. Predicting Outcomes

Predicting outcomes for chronically dependent ventilator patients is extremely difficult, but also extremely important to increasing the cost-effectiveness of care for such patients. Most literature on predicting the outcomes of inpatient care has focused on the patient's condition in the first week of the hospital stay. Relatively little attention has been paid to predicting outcomes for patients who have already been hospitalized for a long period, because of dependence on a ventilator or for some other reason.

There is more work that could be done in this area using the data that were collected for this project, although some effort would be required to improve the quality of the clinical data. We had some limited success in predicting outcomes using information from "Day 21" of the patient's ventilator episode, but missing data, especially for UCDSS cases, frustrated our efforts. If HCFA pursues the idea of collecting clinical data on chronic ventilator patients under MQIS (see above), the instrument should be designed to, among other things, facilitate research on this issue.

D. Post-acute Care and Outcomes

As stated previously, we know very little about the ventilator dependent patients' post-acute care. Future research should include attempts to understand the linkages between the hospital and the various post-acute settings and among the different settings themselves. The health care system is moving increasingly to integrated systems of care, more closely approximating the continuum of care thought of by many people as optimum. However, the frequent changes among settings evidenced in this study suggest that the continuum of care might not be as beneficial to the ventilator dependent patient as one might think. The only way to determine whether frequent changes among settings is beneficial or detrimental to the patient is to assess the effects empirically.

Health care researchers have long used re-admission to the hospital as an outcome measure and an indicator of negative outcomes. The high rate of hospital readmissions for the ventilator dependent patients we studied supports the need to study quality of care and outcomes. Hospital readmissions may be the nature of chronic illness, especially for ventilator dependent patients, rather than an indication of poor quality care.

Approximately 225 of the cases in the UCDSS sample have post-acute claims. The VDU cases include an additional 165 patients with post-acute claims. The existence of these data provides HCFA with opportunities to answer additional questions about post-acute care for this patient population.

Reimbursement incentives may account for some of the frequent changes among settings we observed for the ventilator dependent patients we studied. It is possible that patients who were in hospitals with hospital-based SNFs, rehabilitation units or home health agencies had more setting changes than patients in hospitals without such entities. The patients in the UCDSS sample and four VDU units provide an opportunity to determine whether patients discharged from hospitals with hospital-based post-acute settings have different post-acute patterns of care than patients discharged to post-acute settings that are not affiliated with hospitals. This type of research would help determine on a preliminary basis whether the frequent changes in setting observed in this study are related to reimbursement incentives.

Using the claims data, we have been able to describe the course of care for patients from the end of their discharge through the end of our observation period, or until death. We have enough data to develop multivariate models of post-acute outcomes. Although developing models of post-acute outcomes was not a part of the current study, we did develop some models that illustrate what could be done: the models of post-discharge survival and of expenditures for the 18-month period beginning at hospital admission. We could, for instance, study episode of care Medicare costs (controlling for patient acuity) for patients discharged to a SNF versus a long-term care hospital versus a rehabilitation setting versus home. As more claims data become available for these cases, it would be possible to improve the outcome measures at a relatively low cost.

CHAPTER TWO

LITERATURE REVIEW

I. INTRODUCTION

Early on in this project we reviewed the literature on the acute and post-acute care of chronic ventilator dependent patients.[1] This review is an update of the earlier review, incorporating many items that have appeared in the literature since that time.

For the current review we conducted an electronic search of multiple databases and a review of trade publications, newsletters, and additional sources of literature not found in the databases. The literature review update included an automated search of seven databases: 1) AgeLine, 2) EMBASE, 3) Health Periodicals, 4) Health Planning and Administration, 5) Medline, 6) Psychinfo, and 7) the Trade and Industry Database for literature from 1992 to present. Key words used for the database searches included: ventilator, ventilation, ventilator patient, nursing home, nursing facility, and post-acute. We also examined additional articles published in and before 1992 to provide some overlap with the 1992 literature review and to ensure that we captured as much of the relevant literature as possible. Studies mentioned in the literature and reference lists from articles included in the literature review were used to identify additional sources.

In the next section we examine the findings in the literature on outcomes for chronic ventilator dependent patients. In the following section we discuss the literature on post-acute care and recent developments in the provision of post-acute care.

II. LITERATURE ON OUTCOMES FOR CHRONICALLY DEPENDENT VENTILATOR PATIENTS

We have previously reviewed the studies that examined weaning or mortality outcomes for long-term ventilator patients (Lewin-ICF, 1990). Findings from previously reviewed studies as well as more recent studies are summarized in Exhibit 2.1. In our previous review, all studies examined included many patients whose ventilator episodes were quite short -- as short as three days in some cases. We did not find any studies that included only patients with relatively long minimum stays -- more appropriate for comparison to both the VDU and UCDSS cases considered here. Eight studies of cases with long minimum stays have been published in the interim. These appear at the bottom of Exhibit 2.1.

Comparisons across studies are difficult to make because inadequate information is available to systematically adjust for differences in risk. The limited findings with respect to risk factors are discussed in the next section.

---

[1] See Lewin-ICF (1990 and 1992).

In-hospital mortality in the studies we found is typically around 50 percent, and rises rapidly in the post-discharge period. There are, however, important exceptions. Two studies conducted by Dr. Gracey and his Mayo colleagues (1992 and 1994) report exceptionally low mortality rates for patients with long minimum episodes. The second of these studies includes some of the Medicare cases in the Mayo VDU that are included in the database for this evaluation. Weaning rates are also high in both studies -- 87 percent in the first and 88 percent in the second.

Four of the studies cited are of special interest because they examine the clinical and cost outcomes of approaches to ventilator rehabilitation that are similar to those used in the Demonstration. Cohen et al. (1991) report on outcomes for patients before and after the introduction of a multidisciplinary ventilator management team (VMT). While introduction of the team was not associated with a significant reduction in mortality (see Exhibit 2.1), the average length of ventilator episodes fell by 3.3 days. They report savings of $1,303 per episode of care.

Schienhorn et al. (1994) report findings from cases at a regional weaning center (RWC) in California. They do not, unfortunately, provide estimates of the impact of the RWC on clinical outcomes relative to those for care in an ICU or any other setting. They estimate that cost per patient day was $980, which they compare to average ICU costs in excess of $3,000.

All of the 44 patients in the unit studied by Gottleib et al. (1993) met the 21-day minimum episode requirement that was used for the VDU Demonstration. Only 34 percent of these patients were weaned.

The last of the four studies of care that is similar to the care provided by the VDUs is Gracey et al. (1994). They compare the outcomes and costs for 132 admissions (129 patients) to the Mayo VDU between January 2, 1990, and December 31, 1992 to those for 104 patients who had been ventilated for 29 days or more at the same hospital (Saint Mary's) between 1986 and 1988. The VDU Demonstration started at the Mayo unit started on January 1, 1992, so the VDU cases in this study include many pre-Demonstration cases. Non-Medicare cases are also included. While the HCFA admission requirements were not in place before the start of the Demonstration, many candidates for VDU admission were not admitted because they were judged unsuitable for VDU care.

The mortality rate of 10 percent for VDU cases (Exhibit 2.1) compares to 42 percent in the comparison group. The difference in mortality is smaller after adjusting for the fact that patients with multi-organ failure were not admitted to the VDU; when similar patients are excluded from the comparison group, the mortality rate drops to 29 percent. Statistically significant differences in mortality remained after additional adjustments for differences in patient characteristics and the clinical cause of the ventilator episode.

Exhibit 2.1

Weaning and Mortality Outcomes in Other Studies

Study	Number of Cases	Patient Type	Minimum Episode Duration	Percent Weaned	Mortality		
					In-hospital	1 Yr. Post Discharge	Longer Term
Studies of Cases with Short Minimum Episodes							
Sluiter, 1972	46	COPD	n.a.			54%	
Petty, 1975	18,077	M/S	≥ 24 hrs.		25%		
Zwilich, 1975	354	all ICU	> 1 hr.		36%		
Pierson, 1978	113	M/S, age ≥ 70	n.a.			55%	
Nunn, 1979	100	all ICU	4 hrs.		33%	53%	70% (4 yrs)
Davis, 1980	44	M/S	48 hrs.		56%	63%	72% (2 yrs)
Schmidt, 1983	137	M/S	48 hrs.		64%		72% (3 yrs)
McClean, 1985	1018	M/S all ages 65+	n.a.		 18% 34%		
Witek, 1985	100	all ICU	n.a.		50%	67%	
Craven, 1986	233	all ICU	48 hrs.		41%		
Gracey, 1987	150	M/S	48 hrs.		51%		
Gillespie, 1989	327	M/S	24 hrs.		34%		
Knaus, 1989	571	M only	24 hrs.		52%		
Lewin, 1990	102,779	Medicare beneficiaries	any		49%		
Shikora, 1990	20	M/S	n.a.	60%			
Cohen, 1991	 198 165	M/S 66+ w/o VMT w/ VMT	any		 46% 45%		
Kelly, 1993	66	M/S	48 hrs.		47%		
Studies of Cases with Long Minimum Episodes							
Menzies, 1989	55	COPD	14 days		69%		
Elpern, 1989	95	M/S	13 days		67%	84%	86% (2 yrs) 90% (3 yrs)
Indihar, 1991	171	COPD	55 days*	34%	40%		
Gracey, 1992	61	COPD	16 days*	87%	5%		
Gottleib, 1993	44	M/S	21 days	34%			
Cohen, 1993	 22 54	M/S < 80 80+	18 days		 33% 91%		
Scheinhorn, 1994	421	M/S at RWC	49 days*		29%	72%	
Gracey, 1994	132	M/S	21 days**	88%	10%	18%	28% (2 yrs.)

*Mean days before admission to special unit.
**Applies to many, but not all, cases.
COPD: Chronic Obstructive Pulmonary Disease
ICU: intensive care unit
M/S: All medical and surgical cases
VMT: Ventilator Management Team
RWC: Regional Weaning Center

III. POST ACUTE LITERATURE

We have conducted two literature reviews for the post-acute care segment of this study. The first literature review appeared in 1992 under the title *Evaluation of the Ventilator Dependent Unit Demonstration Draft Issues Paper on Analysis of Chronic Ventilator Patients in Alternative Care Settings* (Lewin-ICF, 1992). The current literature review updates the 1992 review.

This post-acute care literature review provides an overview of the more recent literature that provides information about chronic ventilator patients in alternative or post-acute care settings. This review begins with an explanation of the method we used to identify relevant literature. After a very brief review of the historical relevance of chronic ventilator patient care in post-acute settings, we then examine what is known about the characteristics of chronic ventilator patients as reported in the 1992 literature review and discuss the contribution of the more recent literature to knowledge of patient characteristics. We then review key findings on the cost of care for chronic ventilator patients from the 1992 literature review and provide updated information from the more recent literature. One area of the literature where we found a considerable difference between 1992 and now was the development of alternative settings with the capability to care for chronic ventilator dependent patients. We discuss this development and then discuss the major reimbursement issues related to the care of chronic ventilator patients. We conclude the current post-acute literature review with a discussion of the implications suggested by both the pre-1992 and the more recent literature.

A. Characteristics of Chronic Ventilator Patients in Alternative Care Settings

Chronic ventilator patients began to receive care in non-acute settings during the polio epidemics that occurred in Europe and the United States in the mid-1900s. As the 1992 review of the literature points out, negative pressure ventilators and the stability of many polio patients on ventilators made home care the preferred alternative to other acute and alternative settings. Home care has become increasingly prevalent over the last couple of decades as the number of chronic ventilator patients and their survival rates have increased.

For the 1992 review, we found that there was little information on the characteristics of chronic ventilator patients. Nor were there estimates of the number or volume of chronic ventilator patients in alternative care settings or studies of post-acute lengths of stays for chronic ventilator patients in alternative care settings.

The 1992 literature review reported on the types of patients that researchers found to be more or less likely to be good candidates for care in the home setting. Patients with skeletal (e.g., scoliosis) or neuromuscular disorders (e.g., spinal cord injuries) were considered strong candidates for discharge to home health care by two researchers (Make, 1986; Fischer & Prentice, 1986) due to their general medical stability, few co-morbidities, and limited suctioning requirements. Similarly, patients with restrictive pulmonary diseases who were clinically stable and, on average, younger also were considered strong candidates for home

health care (Fischer & Prentice, 1982). Conversely, COPD patients were not considered strong candidates for home care due to greater suctioning requirements, the number of co-morbidities, and the progressive nature of the disease (Make, 1986; O'Donohue, 1986). Patients who were ventilator dependent for less than 24 hours per day also were considered to be better candidates for home care (O'Donohue, 1986). Researchers found that patient age was related to diagnosis: older patients were more likely to have COPD and co-morbidities (Fischer & Prentice, 1982; Make, 1986).

More recent research seems to contradict the importance of age as a predictor of survival and a small study even raises the question of the importance of diagnosis. A meta-analysis of studies with a total of more than 2000 patients found the effect of patient age on survival appeared to be less of a predictor of survival than researchers expected and diagnoses appeared to more predictive (Krieger, 1994). In their study of 44 patients, Gottlieb and Celli (1993) found that neither age, diagnosis or other clinical indicators was a significant predictor of discharge to home.

The 1992 review found that several social and psychological factors were important considerations in the placement of ventilator patients in alternative care settings. A motivated and available family; a highly motivated and psychologically stable patient; a comprehensive discharge team and education program; and an adequate physical home environment were thought essential to successful long term home care. Recent research supports the importance of the family: in one small study of 44 patients admitted to a chronic ventilator support unit the presence of a family was the only significant predictor of discharge to home (Gottlieb & Celli, 1993).

B. Costs of Caring For Ventilator Dependent Patients in Alternative Settings

In the 1992 literature review we found that there was a lack of information on issues related to the costs of caring for patients in alternative care settings, except for comparisons of costs of home care and hospital care. Some of the literature gathered for the 1992 review maintains that costs of caring for chronic ventilator patients in the home are lower compared to costs of care in the hospital. Yet, for these studies, hospital "charges" were used rather than actual "costs" (Lewin-ICF, 1992) As well, it was not clear whether or not the studies controlled for patient acuity when comparing resource use. Despite methodological issues, the 1992 review concluded that when all related costs (e.g., equipment, home renovations, staffing) are considered, home care can be a lower cost alternative compared to hospital care.[2] Home care also is the preferred alternative for patients: patients who went home reported a higher quality of life than patients in the hospital.

The more recent literature also suggests that the cost of caring for chronic ventilator patients in alternative settings can be less than costs associated with hospital care, although

---

[2] One cost usually not counted is the value of care provided by family caregivers (Coleman, 1995).

home care is not necessarily less costly than hospital care. One study conducted a cost analysis of in-home care versus institutionalization for severely physically disabled ventilator-assisted individuals in New York City (Bach, et. al., 1992). The 30 exclusively non-tracheostomized persons in the study lived in the community and directed their attendant care and person affairs. These 30 study subjects were attended by trained, uncredentialed home care attendants who were less costly than in-home nursing for tracheostomy care. This type of care resulted in a savings of 77 percent or $176,137 per year per client.

A 36-month study of 421 patients transferred to a Regional Weaning Center after prolonged mechanical ventilation in the Intensive Care Unit (ICU) determined that the cost per patient day for a weaned patient at home and a weaned patient in an Extended Care Facility (ECF) were $28 and $275, respectively (Sheinhorn et. al., 1994). The costs for ventilator dependent patients were higher than those of weaned patients in general, but the costs for both ventilator dependent and weaned patients were lower in the home setting.[3] The cost per patient day was $405 for a ventilator dependent patient at home, compared with $600 for a ventilator dependent patient at an ECF. The study concluded that the RWC care was $208 per patient day less costly than noninvasive respiratory care unit care and about $1,500 per patient day less costly than ICU care.

There is little information on the cost of other alternative post-acute settings, such as skilled nursing facilities, rehabilitation settings, or long-term care hospitals. The nursing home industry has asserted that Medicare can reduce costs appreciably for ventilator supported patients transferred to a skilled nursing facility (SNF) (American Health Care Association, 1994). They estimate that the cost of a SNF day for a ventilator supported patient with a respiratory system diagnosis (DRG 475) to be $400. In contrast, one nursing facility has maintained that it can provide care for ventilator patients at approximately $700 per day, in comparison to hospital costs between $1,500 and $4,000 per day (George, 1995).

The amount of nursing care or attendant care provided a patient appears to be a major determinant of the total costs of care, regardless of setting. In the ICU, Krieger (1994) found that nursing contributed 44 percent of the variable costs involved in caring for mechanically ventilated patients (variable costs included nursing, laboratory, respiratory care pharmacy, and radiology). In a New York State study of ventilator assisted individuals maintained in the community, the mean daily cost of attendant care was $191 (s.d. $49) out of $235 (s.d. $56) or 80 percent of the total costs. A cost comparison for chronic ventilator care in an intensive care unit, group home and three different home care options found that monthly home care costs for patients varied based on the amount of nursing required (Indihar, 1991). Home care requiring around-the-clock nursing (RN or LPN) cost more per month than the ICU.

---

[3] Sheinhorn et al. (1994) also did not include the value of care provided by family caregivers.

Substituting an attendant for 12 to 14 hours and a family caregiver for the 24 hour licensed nurse brought the cost of home care down substantially, from $34,665 to $8,265 per month.[4]

C. Recent Development of Alternative Settings for Ventilator Dependent Patients

At the time of the 1992 literature review, it appeared that there were only a limited number of alternative care settings that provided ventilator care. According to a Gallup survey conducted for the American Association of Respiratory Therapists, there were approximately 11,419 long-term ventilator dependent patients in U.S. hospitals in 1991. About 30 percent of those patients remained in the hospital for non-medical reasons, such as reimbursement issues or lack of placement options (Sevick, et al., 1994). The studies reviewed in 1992 indicated that most chronic ventilator patients who were able to be discharged from the hospital eventually went home. The 1992 review suggested that, in the short term, ventilator dependent patients who were more likely to require a higher level of care than could be provided in the home were discharged to a skilled nursing facility or other long-term care facility. Yet, researchers hypothesized that many of these patients would stabilize over time and ultimately would be able to return home.

One of the key issues regarding ventilator patients involves the emerging phenomenon of "subacute care" (Lewin-VHI, 1995). While the term "subacute care" was not mentioned at all in the 1992 literature review, the more recent literature, particularly in provider publications, emphasizes the provision of ventilator services in post-acute care settings. The literature in academic journals addresses mainly the clinical issues involved in the care of ventilator dependent patients in various settings. The literature in provider publications describes the potential growth opportunities for subacute providers in the area of ventilator patient care.

Ventilator patients frequently are cited in the literature as an example of a subacute care patient. In 21 articles published from 1990 through 1994 that described the type of care provided subacute patients, 14 articles mentioned ventilator patient care (Lewin-VHI, 1994). Although ventilator patients frequently are considered to be one type of subacute patient, the number of self-identified subacute facilities actually providing ventilator care is not known. A 1994 survey of 95 freestanding nursing facilities in Massachusetts found that 65 percent of the facilities asserted that they provided "medical subacute care" but only eight percent of those surveyed provided ventilator care (Massachusetts Federation of Nursing Homes, 1994). A 1995 survey of approximately 140 members of the National Subacute Care Association determined that 93 or 66.4 percent of the facilities offered ventilator care (Atieri, 1995).

For the 1995 Department of Health and Human Services (DHHS) study of subacute care, researchers interviewed a number of self-identified subacute care providers (Lewin-VHI,

---

[4] The cost of home care in this study apparently does not include a value for the time the family caregiver provided care.

1995). There was wide agreement among providers that clinically stable ventilator patients were suitable subacute patients. The researchers visited 19 facilities on-site: 10 of the 19 facilities visited provided care to ventilator patients.

The more recent literature cites several reasons for the development of subacute care. First, in an effort to foster growth, nursing facilities are offering more than the traditional custodial nursing home care and are expanding the types of services offered at their facilities (Burns, 1993). Second, facing pressure from utilization management, physicians are more willing to move patients to alternative settings (Perrone, 1994). In the past physicians were concerned for the safety of patients in alternative settings, but more facilities now accept higher acuity patients and purport to provide adequate care for those patients. Third, some nursing home chains are establishing integrated health networks of services for the elderly (Burns, 1993). The programs being developed include "subacute and specialty-care units," among others and some of these units focus on respiratory therapy, pulmonary care, and/or ventilator care.

The DHHS study of subacute care found that some of the key factors contributing to the growth of subacute care are the three reasons mentioned above but added a number of other factors, especially Medicare payment policy. Medicare is the largest payor for subacute care (Lewin-VHI, 1995). As the 1992 literature review pointed out, many chronic ventilator patients are Medicare eligible, qualifying by their age or disability. In the next section, we will briefly discuss reimbursement for ventilator dependent patients in post-acute settings.

D. Implications From The Two Literature Reviews

To date, little is known about ventilator dependent patients in post-acute settings. We do not know the most basic information about ventilator dependent patients in post-acute settings. What little we do know comes from research using small samples that cannot be generalized to the larger ventilator dependent patient population. Researchers interested in examining post-acute care for ventilator dependent patients, in essence, start with a clean slate.

There are only a few impressions that one can glean from the literature. These impressions include some patient characteristics that may or may not be influential: that age, diagnosis, family availability, and the amount of dependence on the ventilator may be predictors of a patient's post-acute discharge destination.

CHAPTER THREE

DATA

I. INTRODUCTION

In this chapter we summarize the methodology and instruments used to collect clinical data for the Demonstration and comparison group cases, describe the instruments used to collect the data, discuss important limitations of the clinical data, and then describe how we supplemented the clinical data with data from Medicare claims and mortality databases.

As discussed in more detail in Section III of this Chapter, the comparison group for this study was selected from patients whose Medicare Part A discharge claim indicated a strong likelihood that their hospital stay included a ventilator episode of at least 21 days duration. Clinical data from these patients' hospital records were extracted using a version of the computerized instrument for HCFA's Uniform Clinical Data Set System (UCDSS) that had been specially modified for this project. The cases that were found to have a ventilator episode of at least 21 days were included in the database for the comparison group. Clinical data for VDU cases were collected by the VDUs themselves, using instruments that we especially designed for that purpose.

For a variety of reasons, a substantial number of VDU cases and a smaller number of UCDSS cases for which we have at least some data were not used in the analysis. We have some data on a total of 402 VDU cases, representing 353 patients. Of these cases, 18 are non-Medicare cases or were Medicare cases with no Medicare identification number, 49 are for readmissions to the VDUs, we could not locate complete claims data for 62, 37 used non-invasive ventilators in the VDU (all from Temple), and 23 had length-of-stay and/or length-of-ventilator episode of less than 20 days, leaving a sample of 211 cases for the analysis. We dropped the readmissions and non-invasive cases from the analysis because we did not have appropriate comparison data. For UCDSS cases, we have data on 444 total cases, but dropped 2 that were readmissions, 15 with incomplete claims data, and 26 because of a short length-of-stay and/or short ventilator episode, leaving 401 cases for the analysis.

Unless otherwise indicated, the sample sizes used in the analyses we report here are those appearing in Exhibit 3.1.[1] Note that we have divided the cases from the Mayo VDU into two groups, those whose stay in the VDU preceded the Demonstration period, and those whose VDU stay was during the Demonstration period. We have treated these cases separately throughout both because the VDU admission criteria were not in place before the Demonstration and because the reimbursement methodology did not change until the Demonstration started.

---

[1] Actual sample sizes used in specific analyses are usually smaller, for a variety of reasons.

Exhibit 3.1

Sample Sizes

Group	Sample Size
UCDSS	401
VDU	211
Mayo (pre-demonstration)	15
Mayo (during demonstration)	35
Sinai	18
RMS	86
Temple	57

Clinical data were collected at three points during the hospital stay. For most patients, these points are: at or near hospital admission; on a date that is very close to 21 days following the beginning of the patient's ventilator episode ("Day 21"); and at or near hospital discharge.

We supplemented the clinical data for both VDU and UCDSS cases with expenditure, diagnostic, hospital discharge status, and mortality data from Medicare claims and enrollment data. Claims data for each case were extracted for a 30-month period, beginning 12 months prior to the hospital admission for the hospital stay associated with the ventilator episode and ending 18 months after the same date. The claims data for the 30-month period were divided into three subperiods: the "pre-admission year" (i.e., the first 12 months of the 30 month period), the period of the hospital stay associated with the ventilator episode (i.e., the period coincident with the period in which clinical data were collected), and the "post-discharge" period (i.e., the period from hospital discharge through the end of the 30 months).

We examined a fixed-length period after hospital admission rather than a fixed-length period after hospital discharge because the demonstration may affect hospital length-of-stay. Length of stay may be reduced if the the VDUs wean patients more quickly, but may be lengthened if they increase longevity. In addition to possible clinical effects, the financial incentives under the Demonstration favor longer stays relative to those under PPS. Under PPS, the hospital receives no additional reimbursement for each day of care unless the outlier limit is reached, while under the Demonstration hospitals were reimbursed at 50 percent of cost.

Hence, the Demonstration may result in longer stays and potentially higher costs during the stay, but the longer stay and higher costs may be offset by less care and lower costs in the post-discharge period. To take this into account, we needed to examine costs over a fixed-length period that included both the hospital stay and several months after discharge. We

preferred a longer period than 18 months, but 18 months is the longest period we could feasibly collect data for.

One final important data element was not routinely available from any of the sources considered above: post-discharge mortality. Some VDU cases were followed after discharge by VDU staff, and the staff reported known instances of mortality. We also examined the Medicare Enrollment Data Base (EDB) for reported deaths among both VDU and UCDSS cases.

A summary of the sources of data for the VDU and comparison group cases appears in Exhibit 3.2. Differences in the way that some elements of the VDU and UCDSS data were collected affect the analysis, in two ways. First, some differences are recognized explicitly in the specifications of some statistical models, especially in regard to measuring risk. Second, comparability of data is an issue for some variables.

Exhibit 3.2

Summary of Data Sources

Type of Data	Source for VDU Cases	Source for UCDSS Cases
Diagnostic, hospitalization, and expenditure data in 12 months preceding hospital admission	Part A and B Medicare claims	
Medical history and acute conditions at the beginning of the ventilator episode	VDU instrument for initiation of ventilator episode and Part A and B claims	UCDSS hospital admission and medical history data and Part A and B claims
Medical condition on "Day 21" of ventilator episode	VDU admission instrument	Special UCDSS module for long-term ventilator patients
Clinical condition at hospital discharge	VDU discharge instrument and Medicare Part A hospital discharge claim	UCDSS hospital discharge data
Expenditure during hospital stay	Part A and B Medicare claims	
Expenditure post hospital discharge through 18 months following hospital admission, by provider type	Part A and B Medicare claims	
Post discharge mortality	VDU reports and Medicare Enrollment Data Base	Medicare Enrollment Data Base

II. DEMONSTRATION UNIT CLINICAL DATA

A. Collection Methodology

Each of the Demonstration VDUs agreed to collect data for the evaluation as a condition for participating in the Demonstration. We developed hardcopy and computerized instruments for this purpose and delivered them to the VDU staff who were to collect the data. Some of the VDUs filled out and returned hardcopy forms, which we then entered into the VDU

clinical database, while others used the electronic forms and transmitted files that were electronically added to the data base.

Most of the data were collected retrospectively by extracting information from VDU clinical records as well as from hospital records for periods prior to VDU admission. This was a very time consuming and tedious process because the long hospital stays and the complex conditions and treatments of these patients make their hospital records voluminous. Some data for more recent VDU cases were collected prospectively.

The process of data collection was further complicated for many patients by the fact that they were transferred from another hospital to the Demonstration hospital. Pre-VDU clinical data is of great importance for assessing the severity of a patient's condition before and at VDU admission, so VDU staff had to collect data from the pre-transfer institution for this purpose. This had to be done for all RMS cases and for a substantial number of Temple cases.

Once the data were entered in the database, we checked for inappropriate values and inconsistencies in coding, and made changes when correct values were evident or changed reported values to "missing" if they were obviously wrong, but the correct values could not be determined. Some information was verified through comparisons to information found on Medicare claims. While some problems were solved through consultations with VDU staff, we did not have the time or resources to thoroughly investigate all problems or to validate the data in any other way.

B. Instrument Design

We developed three instruments for the collection of VDU clinical data, one for the initiation of the ventilator episode, one for VDU admission, and one for VDU discharge.[2]

1. Initiation of the Ventilator Episode Instrument

The data collected via the "initiation" instrument refer to either medical conditions that were pre-existing at the time the ventilator episode began ("pre-existing conditions" or PXCs) or to acute conditions that precipitated the ventilator episode ("acute precipitants" or APs). In the vast majority of cases the ventilator episode began on the day of hospital admission or within the first few days. Some patients were, however, using a ventilator in another setting, before hospital admission, while others had lengthy hospital stays prior to the beginning of the ventilator episode.

The initiation instrument requires the data collector to provide detailed information on: the circumstances under which the episode was initiated; pre-existing as well as acute respiratory conditions; possible surgeries, treatment complications, and accidents; vital signs; and functional status (activities of daily living, or ADLs) prior to the episode. The data collector

---

[2] Hardcopy instruments appear in the appendix to this report.

is also asked to identify the existence of pre-existing conditions or acute precipitants of the ventilator episode in each of eight organ systems (cardiovascular, nervous/muscular; hematological; renal; endocrine/metabolic; gastrointestinal; immune; and urogenital) and then to provide detailed information on all conditions identified.

2. VDU Admission Instrument

The data on the "VDU admission" instrument refer to the date on which the VDU evaluated the patient for admission to the VDU. In most cases this evaluation was conducted a few days before VDU admission, but in some instances it was conducted well in advance of admission. Many of the evaluations were conducted on, or within two to three days of, the twenty-first day of the ventilator episode because for most patients the VDU admission criteria did not permit VDU admission until at least the twenty-first day. There were important exceptions, however, especially in the case of patients who were transferred from other hospitals; many of these patients were not evaluated until well after the twenty-first day. We refer to the VDU admission data and the corresponding data for UCDSS cases as "Day 21" data. While this label is approximately correct for most cases, it is substantially incorrect for some.

The data required by the VDU admission instrument include: information about the patients circumstances on the date the information applies to; detailed information on the condition of the patient's respiratory and cardiovascular systems; instrumentation information; ADLs; and height and weight. The instrument also requires identification of conditions currently affecting other organ systems, and asks for detailed information about the condition of each organ system identified.

3. VDU Discharge Instrument

The data on the "VDU discharge" instrument refer to the patient's status on the patient's last two days in the VDU, and to the post-discharge plan. For a large majority of cases the VDU discharge date is also the date of discharge from the VDU hospital, or to a rehabilitation unit in the same hospital, but in some cases the patient was discharged to another acute care unit in the same hospital.

The VDU discharge data include mortality data (including mortality after discharge, if known); discharge destination; post-discharge caregiver; weight; ventilator status information (including date of weaning, if weaned); use of medical devices; training for post-discharge care; ADLs; and medications.

C. Strengths and Limitations

The VDU instruments were designed to provide a comprehensive picture of the course of each patient's episode, from pre-existing conditions, through initiation of the ventilator episode and VDU admission, until VDU discharge. Most records provide that picture when examined individually, and it appears that the staff of the VDUs made good-faith, intensive

efforts to create that picture. We do not know of other databases of this size that provide such detailed, longitudinal information about long-term ventilator patients. We also have substantial confidence that the data and analyses presented are reasonably accurate representations of the clinical aspects of these episodes.

The VDU clinical data do suffer from several limitations, however, some of which have already been indicated. These include:

1. We have not had the resources to investigate all missing or miscoded data, or to validate the data;
2. The date for the collection of VDU admission data is substantially different from the twenty-first day of the ventilator episode in a large minority of cases, making comparisons across cases on "Day 21" problematic;
3. In order to ease the burden of data collection, most items were designed to be checked if the stated condition were true, and otherwise to be left blank. Thus, the response to such items did not distinguish between "not true" and either "unknown" or "unanswered." In many cases we could distinguish between these possibilities on the basis of related information, but in other cases there were ambiguities.
4. The most important limitations have to do with comparability of the data to that for the comparison group (UCDSS) cases, an issue we return to after we summarize how the latter were collected.

III. COMPARISON GROUP CLINICAL DATA

A. Introduction

The comparison group clinical data were collected using a version of the computerized instrument for the Uniform Clinical Data Set System (UCDSS) that included a section which we designed for this study -- "Section D." The UCDSS was a HCFA-sponsored project to develop a method to abstract clinical data from hospital records on inpatient stays for use in case reviews by Physician Review Organizations (PROs) and for epidemiological research. A more detailed description of the UCDSS appears in the appendix. HCFA has since abandoned this project in favor of the Medicare Quality Indicator System (MQIS), which is currently being developed.[3]

We chose to collect data via the UCDSS after examining information on existing databases that had extensive clinical data on long-term ventilator patients and finding that the number of cases with stays of 21 days or longer in any single database was very small. The UCDSS appeared to be a practical way of collecting information on a reasonably large number

[3] The UCDSS instrument was designed to collect data for all inpatient stays in acute hospitals, regardless of their nature. For the MQIS, HCFA is developing a set of instruments that are specific to high prevalent, high cost medical conditions.

of cases over a short period of time. At the time data were collected for this study, the UCDSS was being tested in five states. The number of cases being collected was very large, and it first appeared that a reasonably large sample of cases appropriate for our comparison group would be found in time to complete the evaluation through the normal course of UCDSS data collection activities.

The UCDSS instrument being tested prior to use of the system for this project was inadequate for our purposes in several respects. Most importantly, little information was collected on the length and outcomes of ventilator episodes, and there was no systematic attempt to collect data from around Day 21 -- data that we needed to assess comparability of UCDSS cases to VDU cases. We designed Section D to address these shortcomings. A few other modifications to the instrument were also made to accommodate our needs.

The UCDSS data were collected by Peer Review Organizations (PROs) and the database was developed by Fu Associates, Inc., both under contract to HCFA. The PROs obtained medical records for Medicare patients from hospitals in the participating states for this purpose. Normally, cases were selected from HCFA's 5% sample of Part A hospital discharge claims in the participating states. The PROs used a special methodology for selecting cases for this study, however, for practical reasons.

B. Selection of the Comparison Group

We initially asked the PROs to collect data for this study from the 5% sample in the participating states. After collecting the hospital records, the PROs identified all hospital stays that involved a ventilator episode of at least 21 days, following the instructions in Section D. This approach proved to be impractical, however, for two reasons. First, the number of suitable cases identified in this way was smaller than expected, and it became clear that we would not get enough cases for this study if we continued to follow this procedure. Second, abstracting records for the selected patients was extremely time consuming, in part because the records for such patients are so voluminous, and in part because individual abstractors were developing little experience in applying Section D because cases were encountered so infrequently.

We therefore worked with the PROs to develop an alternative procedure for selecting cases, one that would both assure a reasonably large sample in a short period and allow abstractors to acquire concentrated experience in the application of Section D. The selection procedure we developed required them to select all Part A discharge claims that were paid under DRG 483 and that had a length of stay of at least 21 days until they had collected at least 400 cases. The selection criteria were based on an analysis of claims information for the 73 cases that had been identified under the initial procedure. Seventy percent of these claims (51) were paid under DRG 483, and all of these involved hospital stays of at least 20 days -- usually much longer. The second most commonly encounter DRG was 475, which was encountered just four time (eight percent of the cases selected).

C. Structure of the UCDSS Data

The UCDSS data, in general, contain information from three periods in the hospital stay -- admission, discharge, and the intermediate period. Admission data include information on the patient's socioeconomic and demographic background, medical history, and medical condition and treatment at hospital admission. Discharge data include information on the medical condition of the patient at discharge, functional status, discharge destination and discharge caregiver. The intermediate data include extensive information on surgical and other procedures at all points during the intermediate period. They also include the "most abnormal" values of lab results and other measurements during the intermediate period, with the corresponding dates, for a large number of items.

For patients with very long hospital stays the intermediate data are difficult to collect and use. In the case of long stayers it is very difficult for the abstractor to find the worst value of many items, which may severely compromise the validity of the data. For the researcher, the worst value may be of less interest than the value at a particular point in the stay, as is true in our case.

Section D was designed, in part, to address this problem. Section D requires abstractors to collect information that is comparable to information collected on the VDU admission instrument for the twenty-first day of the ventilator episode, plus or minus a few days for items that are not usually available on a daily basis, and also includes a few specific questions about the initiation of the ventilator episode, which in some cases occurred well after hospital admission. A description of the specific items in Section D, along with other UCDSS instrument modifications that were made at our request, appears in the appendix.

D. Strengths and Limitations

As with the VDU instruments, the UCDSS was designed to provide a comprehensive picture of the course of each patient's hospital care. The UCDSS instrument performs that function well for most cases, and with the modifications we requested, this applies to patients with lengthy ventilator episodes as well. Most of the UCDSS records we used in this study do provide a clear, longitudinal picture of these highly complex cases, and as with the VDU data, we have substantial confidence that the data and analyses based on the UCDSS data are reasonably accurate representations of the clinical aspects of these episodes.

There are, however, important limitations of the UCDSS data collected for this study. We describe limitations that are problematic for use of the data in isolation below, and discuss problems of comparability with the VDU data in the next subsection.

1. Most importantly, the UCDSS data used for this study are not representative of all long-term ventilator episodes for Medicare patients, in part because the data were collected in five states only, and in part because we did not look for cases with DRGs other than 483 after collecting data for the first 73. We think this is not a significant problem for the

outcome analysis. It may be a more significant problem for the national implementation analysis.

2. As with the VDU data, we did not have the time or resources to validate the UCDSS data other than through an examination for, and correction of, obvious errors. We found that many data items that were important for assessing the conditions of some patients were missing. Some of these were "Day 21" items, and the problem may be that requested data for some items could not be found sufficiently close to the twenty-first day of the ventilator episode. Other data that were frequently missing referred to the date on which the ventilator episode started. As will be seen later, these inadequacies led us to modify our methodology for both the admission analysis and the outcomes analysis. In contrast, the quality of the outcome data appears to be very high; presumably these data are relatively easy to collect because most of the information we needed appears in discharge records. The hospital admission data appear to be of better quality than the intermediate data, but not as good as the outcome data.

E. Comparability of Demonstration and Comparison Group Data

While we made substantial efforts to obtain data that were comparable in the two data sets, comparability issues inevitably exist because of the many differences in the ways that cases were selected and data were abstracted. Comparability across the VDUs is also an issue, although less so. By in large, the outcome data are very comparable; data on preexisting conditions, acute precipitants, and medical condition on or near Day 21 are more problematic. The most serious problems are listed below, in diminishing order of importance. We have tried to compensate for these problems in a variety of ways, to be discussed later.

1. The VDU and UCDSS cases were selected in different ways. Most significantly, the VDUs screened out cases, according to established criteria, that were medically unstable and had poor prospects for rehabilitation. No similar screen was applied in collecting the UCDSS data, and we would expect the screening conducted by the VDUs to have had a positive impact on outcomes relative to those for UCDSS patients. Although the UCDSS data include information that can be used to assess the suitability of UCDSS cases for admission to a VDU-type unit, any such assessment is necessarily imperfect because of the subjective nature of the decision. In fact, in the case studies we found evidence that the Demonstration VDU admission requirements were applied more strictly in some VDUs than in others. This problem is exacerbated by many missing values for variables that would be useful in judging VDU eligibility, especially in the UCDSS data. We examine this issue in more detail in the Chapter 4.

2. Related to the first point, many UCDSS data elements that are critical to assessing eligibility and severity were collected on or near Day 21, while in the case of many VDU patients the presumably comparable data were collected on a date that was substantially different from the twenty-first day. In some cases, the VDUs identified and assessed

potential candidates a week or more in advance of the twenty-first day; this was most likely to happen for patients who were in the ICU at the same institution. At the other extreme, some candidates were not evaluated until one or more weeks after the twenty-first day; this was most likely to happen for patients who were in some other hospital and were later transferred to the VDU hospital. Many RMS patients, all of whom were transferred from other hospitals, were evaluated well after the twenty-first day.

3. There are also differences in the timing for the collection of ventilator initiation data. For VDU cases, all data on the acute precipitant(s) of the ventilator episode refer to the patient's condition on the date of ventilator initiation. For UCDSS cases, some of these data are based on the date of ventilator initiation, but others are for the first 24 hours of the hospital stay. While the majority of ventilator episodes begin within a very few days of hospital admission, some begin many days, or even weeks, later. Further, in a few VDU cases the patient had been using a ventilator in a subacute setting before hospital admission, so the initiation data refer to a date before hospital admission.

4. A few VDU patients were discharged from the VDU to another unit in the same hospital, so the VDU discharge data for these cases do not correspond to hospital discharge data.

The periods over which UCDSS and VDU cases were collected varied, and there was also variation in collection periods across VDUs. The first and last admission dates for each group of cases appear in Exhibit 3.3.

Exhibit 3.3

First and Last Hospital Admission Dates

Group	Range of Admission Dates	
	First	Last
UCDSS	June 17, 1992	August 17, 1994
VDU	September 13, 1989	October 16, 1991
Mayo (before Demonstration)	September 13, 1989	October 16, 1991
Mayo (during Demonstration)	September 14, 1991	July 12, 1994
Sinai	September 30, 1992	March 17, 1995
RMS	November 17, 1993	February 3, 1995
Temple	April 14, 1991	April 30, 1994

IV. MEDICARE CLAIMS DATA

A. Claims Identification

We began by identifying all Part A and Part B claims with Medicare identification (HIC) numbers corresponding to HIC numbers for all UCDSS and VDU cases, from January,1989, through February, 1995. Once we identified the claims, we matched Part A inpatient hospital claims to the dates of the ventilator episodes from the clinical data. In almost all cases, the

hospital stay included multiple claims. For patients who transferred from other hospitals to a VDU hospital for direct admission into the VDU, we included claims from both hospitals. To be consistent with the way hospital stays were defined for UCDSS cases, the stays for VDU patients who were discharged into other acute care units in the same hospital, or to an acute care unit in another hospital, were continued until the patient was discharged from acute care; stays for VDU patients who were discharged into physical rehabilitation units in the same or other hospitals were defined as ending at VDU discharge.

We then extracted data from all claims for the twelve-month period before the hospital admission date and from the 18-month period beginning with the same date.[4] Some hospital stays were too recent to obtain claims for the full 18 months following the admission date.

B. Analysis File

After identifying and extracting the claims we created a person-record analysis file, which was later merged with the clinical data file. The analysis file contains variables for the pre-admission, hospital stay, and post-discharge period.

Five groups of variables are included in the analysis file: expenditure variables, diagnostic indicators, utilization variables, indicators for major surgical procedures, and miscellaneous others. For each period we constructed Part A and Part B expenditure variables by type of provider and type of payer (Medicare, other primary carrier, and beneficiary). For VDU cases, we included variables for Part A expenditures (total and Medicare) during the VDU stay within the hospital stay. We also included indicators of whether the patient had exhausted his or her Medicare inpatient benefit during each of the three periods and, for VDU cases, during the VDU stay.

Three sets of diagnostic indicators were constructed: one for the pre period (based on all Part A and B claims for the period), one for the Part A admission diagnosis for the hospital stay, and one for all other Part A diagnoses during the hospital stay. Each indicator shows the presence or absence of a diagnosis (e.g., chronic obstructive pulmonary disease).

Utilization variables include length of the hospital stay, number of inpatient days in the pre and post periods, and, for VDU cases, number of days in the VDU. The miscellaneous other variables include: patient identifiers; the dates defining each subperiod; the number of days we obtained claims for in the 18-month post-admission period; and final discharge destination from the hospital stay period.

More details on the claims analysis file appear in the appendix.

---

[4] Costs on claims for periods that overlapped the ends of these periods were prorated.

C. Cost Deflators

In order to make meaningful cost comparisons across areas and over time, we "deflated" all expenditure variables to a "national standard" for FY1994. The objective was to measure what expenditures would have been for the services provided using national average Medicare prices for FY1994. Three sets of deflators were constructed and used for this purpose.

For Part A inpatient expenditures, we constructed an index based on Medicare payments for DRG 483. We first calculated the DRG payment rate that was applicable to each case in the hospital and year in which it occurred, then divided it by the 1994 national payment standard to get the deflator. This deflator was applied to convert all Part A inpatient expenditures to an FY1994 national rate.

We deflated all other expenditures in a similar way. For all other Part A expenditures, we used HCFA's Area Wage Index (AWI), rather than the DRG index. For Part B expenditures, we used HCFA's Geographic Practice Cost Index (GPCI).

D. Strengths and Limitations

In general, the claims data appear to be of very good quality. One important feature of the claims data that is absent from the clinical data is that they are comparable across VDU and UCDSS cases. This applies to clinical data (diagnostic indicators) as well as to expenditure and other data. We were also able to use information from the claims data to verify some information from the clinical data, to rectify discrepancies in some cases, and to fill in missing information in others. The dates of hospital admission and discharge and the final discharge destination were all checked in this way. This was particularly important for VDU cases because many involved transfers and because some VDU patients were discharged to other units in the VDU hospital, in which case we could not determine length of stay or status at hospital discharge from the clinical data.

The cost data do have limitations, however. Foremost among these is that we were unable to find hospital claims for some patients that matched the dates of the hospital stay from the clinical data. Although the number of missing UCDSS claims is small, we expected it to be zero because each case was originally identified from the Part A discharge claim. For VDU cases, it is likely that missing claims are due to errors in HIC numbers. We initially searched the claims data for all HIC numbers given to us by the VDUs, plus all cross-reference numbers for those numbers that were provided by HCFA. After completing this search, we were still missing a large number of Part A claims. We then searched for all Part A claims that included the special "T999" code for the Demonstration units. This yielded 22 additional cases, of which 11 were clear matches to cases in the clinical data on the basis of birthdate, hospital, and admission and discharge dates, and all had very similar, but not identical, HIC numbers in the two data bases. We expected that some claims would be missing for recent

episodes due to processing delays, but many of the missing claims are for stays that occurred one or more years earlier. The 11 remaining claims records that were found using the T999 code clearly do not match any of the clinical records we obtained from the units. We also found claims for seven VDU cases that did not include T999 claims, but that clearly matched the hospital stay from the clinical data.

Unless otherwise indicated, all cases used in the analyses we report are cases for which we found Part A claims. Almost all cases have Part B data; due to time constraints, we did not to obtain Part B data for the last 20 VDU cases for which we were able to find Part A data.

V. MORTALITY DATA

As discussed above, in-hospital mortality is indicated in the clinical data. It also appears on the Part A hospital discharge claim. To determine post-discharge mortality, we searched HCFA's Medicare Enrollment Data Base (EDB) for eligibility terminations due to death of the beneficiary and also looked at the discharge destination on later Part A claims for the "deceased" code.

In some cases we found discrepancies between the EDB data, the clinical data, and/or the claims data. In some cases, death would be reported in one or two, but not in the other one or two. It appears that death occurred in these cases, but was simply not reported in all three sources. Another common problem was that the date of death would vary by as much as 10 days across the three sources.

We coded each patient as deceased at hospital discharge if any one of the three sources indicated that he or she died during the hospital stay, and used the hospital discharge date on the hospital claim as the date of death. We assumed that all others were alive at discharge, and continued to live for at least as long as claims were filed on their behalf. If no indication of death was found in either the EDB file or on a Part A discharge claims, we assumed the patient was still alive on the last day covered by any Part A or Part B claim we found for them. That is, we assumed only that the patient survived "at least as long" as the number of days from hospital admission through the last date covered by a claim; such cases are treated as "right-censored" cases in the analysis of length of survival.[5]

---

[5] We initially assumed that patients were alive through the last date we obtained EDB data for, but it became evident that this assumption was incorrect when we looked at claims for some cases and discovered that they ended as long as two years before the last EDB date. We also found cases in which death was indicated on a Part A claim, but was not indicated in the EDB file. We did not, however, find cases for which there were claims covering periods following the data of death that appeared in the EDB file. It appears that dates of death in the EDB files are reliable markers for mortality, but that absence of a date should not be accepted as evidence that the patient is still alive.

CHAPTER FOUR

ADMISSIONS ANALYSIS

I. INTRODUCTION

As discussed previously, the VDUs were allowed to admit patients only if they were judged to be medically stable and to have reasonable rehabilitation potential. Although specific criteria were specified for judging VDU eligibility, they were necessarily subjective. There are several reasons for studying both how the admissions criteria were applied to the VDU cases and the extent to which UCDSS cases satisfied the criteria:

- HCFA would like to know whether it is feasible to implement such complex, yet substantially subjective, criteria in a reasonably uniform way across units that vary greatly in many respects. If HCFA were to implement cost reimbursement payments for all such units, would HCFA be able to insure that these or any other admission criteria were implemented appropriately?
- Outcome differences across VDUs may reflect differences in how rigorously the criteria were applied. As previously mentioned, evidence from the case studies suggests that the VDUs differed in their interpretation of the criteria. Other things equal, we would expect those units who screened patients most rigorously to have relatively better outcomes than those units who applied them less rigorously.
- VDU and UCDSS outcome differences are very likely to be partly explained by the fact that the UCDSS cases were not screened at all. Understanding how the admission criteria were applied to VDU cases, and how they apply to UCDSS cases, is essential for separating the effect of admissions screening from the effect of differences in care when comparing outcomes for VDU and UCDSS patients.
- Knowledge about the share of UCDSS cases that satisfy the admissions criteria will be useful in estimating both the number of Medicare beneficiaries who are potential candidates for VDUs and the cost of national implementation.

In the next section we describe how we performed the admission analysis. We report the findings in the third section.

II. METHODOLOGY

A. Classification of Cases into "Eligibility Groups"

1. Objective

Ideally, we would like to classify all cases, both Demonstration and comparison, into two groups: "eligibles," who at some point in their ventilator episode satisfy the VDU admission requirements, and "ineligibles." We could then determine the proportion of each VDUs

patients who are in the eligible group to assess compliance with the admission requirements in the VDUs themselves. We could also determine how many UCDSS cases would meet the requirements, as well as how many would likely be admitted to a unit if the criteria were applied as in the Demonstration.

This ideal cannot be achieved both because assessing eligibility requires substantial judgment on the part of the physician and because the data we collected, while very rich, cannot possibly give us as clear a picture of the patient's medical condition and rehabilitation prospects as the patient's own physician would have. Therefore, we developed a strategy to group cases in our sample according to the strength of evidence we had that they did satisfy the admission criteria. Using objective criteria, based on the data available, we assigned each case to a group ranging from a group for which there is very little evidence to support admission to a group for which there is strong evidence to support admission. Comparison of the distribution of cases in these groups across the VDUs provides a way to assess how uniformly the criteria were applied in the Demonstration. Comparison of the distributions across VDU and UCDSS groups provides information on how many UCDSS cases would have been admitted to a VDU if they had been considered for admission by the Demonstration VDUs.

In Chapter Five we discuss two other ways that we group sample cases, for a different purpose. To avoid confusion between the eligibility groups discussed here and the two sets of "risk" groups discussed in Chapter Five, it is important to understand the purposes of the groupings and the information considered in determining group assignments in each case. As discussed above, the eligibility grouping is designed to group cases according to the likelihood that they would be judged eligible for VDU admission. This is a limited objective relative to the objective of the risk groups. The risk groups were designed to be predictive of clinical outcomes. While the criteria for determining eligibility are no doubt predictive of clinical outcomes to some extent, the risk group assignments also incorporate information that is of little or no direct relevance to satisfying the admission criteria, including pre-existing conditions and the acute precipitant of the ventilator episode.

2. Eligibility Grouping Criteria

In making the eligibility group assignments, we used only information that would have been available to an attending physician at or near the point in the ventilator episode when the patient would most likely be considered for VDU admission. For comparison cases, this point was always Day 21 -- on or close to the twenty-first day of the ventilator episode. For Demonstration cases the relevant day is the day on which an evaluation of the patient's condition was actually made by VDU staff.

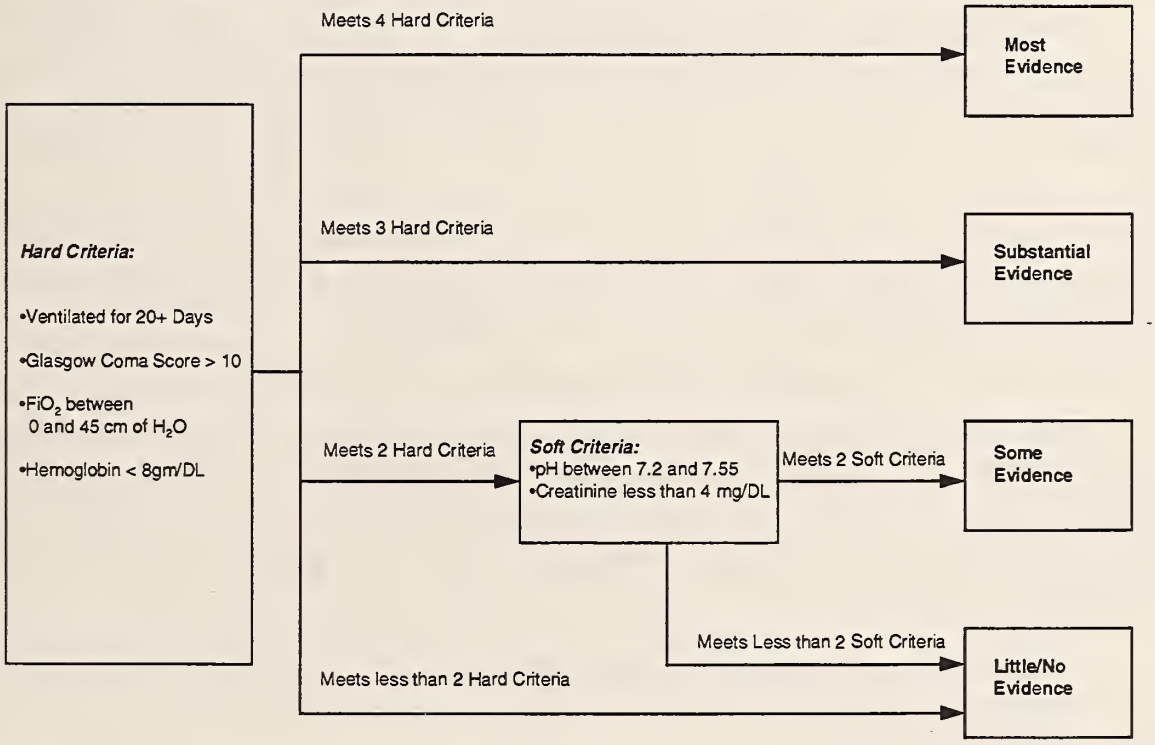
We first developed a long list of criteria for making the assignments, using vital signs, laboratory values, and other conditions that are well established indicators of medical stability in each organ system. We found, however, that the data could not support use of most items

on this list. For both VDU and, especially, UCDSS cases, values for many of the variables were missing. As a result, most cases could not be clearly classified in any group.

Given these circumstances, we developed a much simpler classification scheme -- one that we believed would meaningfully distinguish among patients according to the likelihood that they would be judged eligible by a physician who was implementing the VDU criteria, and that could also be adequately supported by the data. Under this scheme we classified cases into four groups, with "strong", "substantial," "some," or "little or no" evidence favoring eligibility (Exhibit 4.1).

Exhibit 4.1

Eligibility Classification Scheme



There are two reasons to be concerned about whether these groupings make meaningful distinctions among cases according to their true eligibility for admission. First, despite our substantial efforts, the assignment of a specific case to an eligibility group may depend on whether certain data elements are available for that case. Hence, to some degree cases are classified according to data availability rather than according to eligibility. Second, because the groupings are based on only a few of many possible criteria, there is likely to be substantial noise in the groupings, with some cases that we classified in one group actually

having a greater likelihood of being judged eligible than some cases in a higher group. Hence, we undertook a substantial effort to validate the groupings.

B. Validation of Eligibility Groups

1. Introduction

While the grouping criteria necessarily rely on information that is available for almost all cases, for most individual cases there is additional information that has a bearing on the individual's eligibility, but that cannot be used to classify cases into eligibility groups because it is either unavailable or irrelevant for many other cases. In order to assess the validity of the eligibility groups, we examined this information for evidence that would either confirm or contradict the classification of individual cases.

We assessed the validity of the eligibility criteria in two ways. First, for each eligibility group we computed descriptive statistics of selected variables over all cases in the group for which the variable's value is known and examine these for evidence that some cases were misclassified (e.g., were classified as eligible when the value of the variable suggests they would not meet the admission criteria). Second, we had our clinical consultants review detailed records for a small sample of cases for any evidence that would confirm or contradict the assignment that was made on the basis of the eligibility grouping criteria alone. We describe each of these validation exercises in more detail below.

2. Descriptive Statistics for Selected Variables

Each of the indicators listed in Exhibit 4.2 would be helpful in determining whether an individual case meets the VDU admission criteria. These variables are among those that we originally planned to use in creating the eligibility groups, but were not used because of large numbers of missing values or because the variable was not included in the data for one of the two groups.

If the eligibility groups are valid, we would expect very few violations of these conditions in the "most evidence" group, and increasingly frequent violations as we move down to the group with "least evidence."

We also examined variation in outcomes across eligibility groups. Because the admission criteria were designed to exclude patients who were extremely unlikely to benefit from VDU care, we would expect outcomes to be most favorable for the group with the most evidence of eligibility. This is especially true among the UCDSS cases because these cases were not screened for eligibility by VDU staff. The outcome variable we use for making this assessment is hospital discharge status.

Exhibit 4.2

Other Eligibility Indicators

"Day 21" Variable	Values that Violate the Admission Criteria
pH	less than 7.2 or greater than 7.55
serum Na	less than 120 or greater than 150 mg/dl
serum K	less than 3.0 or greater than 6.0 mg/dl
temperature	greater than 102F (39C)
leucocytes	less than 2,500 or greater than 25,000/MM·
creatinine	greater than 4 mg/dl
PAO_2/FIO_2	less than 1.5
failed weaning attempts	none*
albumen	less than 2.5 g/dl
PEEP**	less than 5 mm Hg

*The VDU admission criteria require at least two weaning attempts prior to admission, so this criterion is less strict than the VDU criterion.
**Positive end-expiratory rate.

n.a. - not included in data set

3. Record Review

The second method used to validate the eligibility groups is medical review of clinical information about randomly selected VDU and UCDSS cases. To perform this analysis, we randomly selected 60 VDU cases (15 from each unit) and 40 UCDSS cases for review by our two project clinicians. We provided each clinician with an extract of detailed clinical data on each of the 100 cases. This information included all the information we had for the patient up through Day 21, and no information beyond that point.[1] The clinicians were told whether the case was a VDU or UCDSS case, but for VDU cases they did not know which unit the case was from.[2] Each clinician independently classified each case as "eligible," "not eligible," or "uncertain," and provided a brief explanation for his decision.

III. FINDINGS

A. Eligibility Groups

We found substantially stronger evidence of eligibility among VDU cases than among UCDSS cases. Only 22 percent of UCDSS cases fell into the two groups with the greatest

[1] For VDU cases, this means up through that data on which the VDU admission data were collected, which was substantially earlier or later than the 21st day of the ventilator episode in some cases.

[2] We originally planned to not identify UCDSS vs. VDU cases, but later decided to do so because we would have had to suppress substantial data that were available for one type of case and not the other.

evidence of eligibility, and less than two percent were in the top group (Exhibit 4.3). This compares to 76 percent of VDU cases in the top two groups, including 15 percent in the top group. About 35 percent of UCDSS cases were in the lowest group, with little or no evidence of eligibility. Only nine percent of VDU cases were in the lowest group.

The share of cases in the two top groups for each Demonstration unit was at least 76. This share was substantially higher for Mayo demonstration cases (91 percent) than for all others; the share in the top two groups for the other VDUs had a narrow range, from a low of 70 percent for Temple to a high of 78 percent for Sinai. The share in the top group ranges from a low of zero at RMS to a high of 44 percent at Sinai. At the other extreme, the share in the group with little or no evidence of eligibility ranges from four percent at RMS to 22 percent at Sinai.

B. Validation

1. Violations of Specific Criteria

The examination of more detailed eligibility criteria for those cases for which we could evaluate the detailed criteria found frequent violations of the criteria in all eligibility groups for both VDU and UCDSS cases (Exhibit 4.4). We found that 94 percent of the VDU cases and 86 percent of the UCDSS cases in the top eligibility group violated at least one criterion -- about the same share as in the lowest eligibility group. The relationship between eligibility group and the share violating each individual criteria is also weak. The most frequently violated criterion for the UCDSS cases is the requirement of two failed weaning attempts. Violations of the leucocyte criterion were also common for UCDSS cases, while violations of the albumen criterion were common for VDU cases.

Exhibit 4.3

Eligibility Groups

Group	Evidence to support eligibility	UCDS	VDU					
			Total	Mayo		Mt. Sinai	RMS	Temple
				Demo.	Pre-demo.			
		Number						
1	"most"	7	31	11	2	8	0	10
2	"substantial"	82	129	21	7	6	65	30
3	"some"	172	32	1	4	0	18	9
4	"least"	140	19	2	2	4	3	8
Total		401	211	35	15	18	86	57
		Percent						
1	"most"	1.7%	14.7%	31.4%	13.3%	44.4%	0.0%	17.5%
2	"substantial"	20.4%	61.1%	60.0%	46.7%	33.3%	75.6%	52.6%
3	"some"	42.9%	15.2%	2.9%	26.7%	0.0%	20.9%	15.8%
4	"least"	34.9%	9.0%	5.7%	13.3%	22.2%	3.5%	14.0%
Total		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Exhibit 4.4

Violations of Eligibility Indicators and Outcomes by Eligibility Group

Variable	Eligibility Group: "most evidence" VDU	"most evidence" UCDSS	"substantial evidence" VDU	"substantial evidence" UCDSS	"some evidence" VDU	"some evidence" UCDSS	"little/no evidence" VDU	"little/no evidence" UCDSS	All Cases VDU	All Cases UCDSS
Criteria	**Percent of Cases Violating the Criterion**									
pH	0.0%	0.0%	1.6%	1.2%	0.0%	0.0%	21.1%	0.7%	2.8%	0.5%
serum Na	3.2%	0.0%	3.1%	0.0%	9.4%	0.0%	10.5%	0.0%	4.7%	0.0%
serum K	0.0%	0.0%	0.8%	0.0%	3.1%	0.0%	0.0%	0.0%	0.9%	0.0%
temperature	0.0%	0.0%	0.0%	3.7%	0.0%	0.0%	0.0%	11.4%	0.0%	4.7%
leucocytes	6.5%	57.1%	2.3%	29.3%	0.0%	42.4%	0.0%	35.0%	2.4%	37.4%
creatinine	0.0%	28.6%	2.3%	6.1%	0.0%	1.7%	5.3%	14.3%	1.9%	7.5%
PAO2:FIO2 ratio	0.0%	0.0%	3.9%	4.9%	3.1%	16.3%	5.3%	20.0%	3.3%	15.0%
failed weaning attempts	16.1%	42.9%	22.5%	64.6%	15.6%	57.6%	21.1%	56.4%	20.4%	58.4%
albumen	32.3%	0.0%	32.6%	4.9%	40.6%	2.3%	26.3%	5.7%	33.2%	4.0%
PEEP	3.2%	n.a.	0.0%	n.a.	0.0%	n.a.	0.0%	n.a.	0.5%	n.a.
At least one violation	93.5%	85.7%	97.7%	92.7%	96.9%	91.3%	89.5%	90.7%	96.2%	91.3%
	Outcomes									
Discharge status										
weaned	35.5%	57.1%	40.3%	36.6%	34.4%	40.7%	36.8%	31.4%	38.4%	36.9%
intermittent	6.5%	0.0%	8.5%	1.2%	6.3%	2.9%	5.3%	2.1%	7.6%	2.2%
fully dependent	0.0%	0.0%	2.3%	14.6%	9.4%	11.0%	0.0%	7.1%	2.8%	10.2%
unknown amount	3.2%	0.0%	0.8%	0.0%	0.0%	0.0%	5.3%	0.0%	0.0%	0.0%
deceased	35.5%	42.9%	33.3%	45.1%	43.8%	42.4%	15.8%	58.6%	33.6%	48.6%

The relationship between key outcomes and eligibility groups is also weak. While the weaning rate was high for the few UCDSS cases in the top eligibility group relative to that for other UCDSS cases, the weaning rate for VDU cases in the top group was lower than the rate for all VDU cases. Similarly, while the mortality rate for UCDSS cases has a weak, negative relationship with evidence of eligibility, there is no such relationship for VDU cases. In fact, for VDU cases the lowest mortality rate is for the group with little or no evidence of eligibility.

Thus, although we would expect better outcomes for patients satisfying the VDU criteria, there is no evidence of such a relationship using the evidence of VDU eligibility that is available in the data. While this may indicate that the VDU criteria do poorly in discriminating between patients with potentially favorable outcomes and those who would not benefit from VDU care, another explanation is that the data do not allow us to adequately assess compliance with the VDU criteria. A third possible explanation is more subtle, and also unlikely: the VDU criteria as captured in the eligibility groups are related to outcomes, but only after controlling for diagnoses and other case characteristics, as we do in Chapter 5.

2. Case Review Findings

As anticipated, a substantial share of the 40 UCDSS cases reviewed were judged to be ineligible for VDU admission (Exhibit 4.5): 25 percent by reviewer one and 35 percent by reviewer two. Eligibility in many other cases could not be judged on the basis of information in the UCDSS data (40 and 43 percent respectively), so the shares judged eligible were small (35 and 23 percent, respectively).

Exhibit 4.5

Case Review Findings: Summary

Group	Evidence to support eligibility	UCDS	VDU					
			Total	Mayo		Mt. Sinai	RMS	Temple
				Demo.	Pre-demo.			
		Number						
1	"most"	7	31	11	2	8	0	10
2	"substantial"	82	129	21	7	6	65	30
3	"some"	172	32	1	4	0	18	9
4	"least"	140	19	2	2	4	3	8
Total		401	211	35	15	18	86	57
		Percent						
1	"most"	1.7%	14.7%	31.4%	13.3%	44.4%	0.0%	17.5%
2	"substantial"	20.4%	61.1%	60.0%	46.7%	33.3%	75.6%	52.6%
3	"some"	42.9%	15.2%	2.9%	26.7%	0.0%	20.9%	15.8%
4	"least"	34.9%	9.0%	5.7%	13.3%	22.2%	3.5%	14.0%
Total		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Although both reviewers judged substantially larger shares of the 60 VDU cases to be eligible (58 and 47 percent, respectively) than of the 40 UCDSS cases, the shares of VDU cases judged ineligible are almost as high as for the UCDSS cases (22 and 32 percent, respectively -- each three percentage points below the corresponding UCDSS figure). If the quality of the UCDSS eligibility data was on a par with that for the VDU cases, the shares of UCDSS cases in both the eligible and ineligible groups would presumably increase, so the share ineligible would be clearly greater than for the VDU cases. Without the better data, however, we cannot to tell how large the difference would be.

Comparing findings among VDUs, both reviewers found that Mayo had the highest share of cases satisfying the criteria, about 70 percent, although reviewer one found the same share eligible among RMS cases. Both reviewers also found that Temple had the lowest share of cases satisfying the admission criteria, but disagreed substantially on the size of that share (47 percent for reviewer one vs. 27 percent for reviewer two). Both reviewers rated only 13 percent of Mayo cases as ineligible, but they disagreed on which VDU had the highest share of ineligible cases: reviewer one found that one-third of Sinai cases were ineligible, while reviewer two found that 47 percent of Temple cases were ineligible.

The finding that Mayo had the largest share of patients satisfying the admission criteria, by a wide margin, is in agreement with the finding that Mayo had the largest share of cases in the top two eligibility groups, again by a wide margin. Clear patterns of variation in satisfaction of eligibility criteria are less evident among the other three VDUs.

C. Discussion

The findings from the admission analysis show that it is very difficult to effectively implement a set of complex, subjective admission criteria such as those used in this demonstration. While the fact that a substantially larger share of UCDSS cases than VDU cases fell into the lowest eligibility group suggests that the screening process for the VDU cases did result in some selectivity, the violations of individual admission criteria among VDU cases and the substantial shares of VDU cases that were judged to be ineligible by our clinicians show that there were substantial holes in the screen. The fact that outside reviewers found it difficult to make a judgment in a large share of cases despite a substantial effort to collect detailed clinical data suggests that enforcement of such criteria would be very difficult.

The finding that at least some screening occurred suggests that differences in outcomes between UCDSS and VDU cases will partly be due to differences in screening. At the same time, however, the absence of a strong relationship between critical outcomes (weaning and mortality) and eligibility group, especially for VDU cases, suggests that either differences in screening are not a very important determinant of outcomes, or that the eligibility groups do not capture differences in screening very well. The same comments apply to comparing outcomes across VDUs; the differences between outcomes for Mayo patients and those in any of the other VDUs are the differences most likely to be affected by screening.

The findings also indicate that not all Medicare cases meeting the criteria for selection into the UCDSS sample would be admitted to a PPS-exempt rehabilitation unit under a national implementation of the demonstration, but they are not very definitive about what share would be admitted. One crude way to estimate the share of UCDSS cases that would be admitted is to assume that all those for which we found at least some evidence of eligibility would be admitted, and that the ratio of admissions from the lowest eligibility group to this group would be the same as the corresponding ratio for VDU cases. Under this assumption, 72 percent of UCDSS cases would be admitted.[3] This could be too high because there are no doubt some UCDSS cases in the top three groups who would not be admitted. It may also be too low, however, because more than 31 percent of the UCDSS cases in the lowest eligibility group were alive and weaned at hospital discharge, while the 72 percent figure allows for inclusion of only 18 percent of UCDSS cases in the lowest eligibility group.

The findings from the record review can also be used for estimating the share of UCDSS cases that would likely be admitted. Estimates obtained this way may be more reliable because more data were used in classifying patients. We developed two estimates, based on

---

[3] This share was calculated as follows. For VDU cases, the ratio of those in the lowest group to those in the other groups is 9.0/91.0 = .0989. For UCDSS cases, 261 cases (65.1 percent) were in the top three groups. Multiplying this figure by .0989 yields 26 cases. These cases plus those in the top three groups are 71.6 percent of the 401 UCDSS cases.

the independent findings of the two reviewers.[4] Based on reviewer one's findings, we estimate that about 80 percent of UCDSS cases would be admitted. The share based on reviewer two's findings is 67 percent. These bracket the 72 percent share based on the eligibility groups. In Chapter 6 we use these shares as upper and lower bounds for the share of UCDSS cases that would be judged eligible under national implementaton.

[4] These estimates were calculated as follows. We first split the share of "uncertain" cases for each reviewer and each type of case (UCDSS or VDU) and allocated them into the eligibile or ineligible groups in proportion to the relative numbers in that group. For example, reviewer one reported that 35 percent of the UCDSS cases out of the 60 percent for which he made a decision were eligible, so we assumed that the same proportion of the 40 percent he classified as uncertain would have been judged eligible if better information were available, yielding a total of 58 percent of UCDSS cases in the eligible group. Using the same method, on the basis of reviewer one's findings we place 72.5 percent of VDU cases in the eligible group. We then assumed that enough of the UCDSS cases would not be admitted so that 72.5 percent of the remaining cases would be judged eligible on the basis of the UCDSS data. The reduction in UCDSS cases required to achieve this was 20 percent; i.e., we assumed 80 percent would be admitted. We followed the same procedure with the findings from reviewer two to get the 67 percent figure.

CHAPTER FIVE

OUTCOME ANALYSIS

I. METHODOLOGY

A. Outcome Measures

We examine two types of outcome variables: clinical outcomes and expenditure outcomes (Exhibit 5.1). We measure 15 clinical outcomes and 17 expenditure outcomes.

Five of the clinical outcome variables are duration variables: length of stay in the hospital (LOS), length of stay in the VDU (VDU-LOS, for VDU cases only), length of the ventilator episode (LVE), length of patient's survival after hospital admission, and length of patient's survival after hospital discharge. We have defined LVE to exclude ventilator dependent days before hospital admission. LVE for patients who are ventilator dependent or deceased at hospital discharge is defined as the number of the days from the beginning of the episode in the hospital through the date of discharge, and LVE is treated as (right-) censored for those who were ventilator dependent at discharge. Patient survival after hospital admission includes days alive following discharge through the date of death, if known, and through the last date on which we could determine that the patient was still alive if date of death was not known; the latter cases were treated as censored. Survival after discharge is defined as survival after admission minus LOS.

All other clinical variables are categorical variables based on observations made at hospital discharge.[1] The first four of these are discharge status (indicating mortality and ventilator dependence), ventilator type, discharge destination, and post-discharge caregiver. The next five variables are activities of daily living (ADLs) -- measures of dependence on others in performing essential functions at the time of discharge. A sixth, the "RUGS-III" dependence index, is a measure of dependence that is derived from the last four ADLs.

The Resource Utilization Group (RUGS) methodology groups patients into categories according to the intensity of care resources they are expected to require (Fries et al., 1994). The RUGS-III dependence index assigns patients a score ranging from 4 to 18 based on their ability to perform four ADLs: bed mobility, transferring, toileting, and eating. The RUGS-III score is the sum of the scores assigned for each ADL, based on a "self-performance" measure, in addition to a "support provided" measure in some cases. Bed mobility,

---

[1] As mentioned in the Chapter 3, most VDU patients were discharged from the hospital on the same date they were discharged from the VDU, but in a small number of cases remained in another hospital unit for some period before discharge. Most of the clinical outcomes for VDU patients were obtained from VDU discharge information. For the cases when VDU and hospital discharge dates were different, we used discharge information from the Part A hospital claim to revise the VDU outcome variables when feasible, to make them more comparable to UCDSS outcomes. For instance, if the claim showed that the patient was deceased at discharge, all variable values were changed appropriately.

Exhibit 5.1

Definitions of Outcome Measures

Variable	Definition and Discussion
Clinical Outcomes	
LOS	length-of-stay in hospital (includes days in pre-transfer hospital, if any)
LVE*	length-of-ventilator episode (days on ventilator during the hospital stay -- excludes days on ventilator pre or post discharge)
VDU-LOS	length-of-stay in VDU (VDU cases only)
Survival	number of days survived after hospital admission
Post discharge survival*	number of days survived after hospital discharge
Discharge status	status of patient at discharge from hospital (weaned, ventilator dependent full time, intermittent ventilator use, deceased)
Ventilator type	type of ventilator at discharge (invasive or non-invasive)
Discharge destination	destination at hospital discharge (home, LTC facility, acute care hospital
Post discharge caregiver	primary caregiver after discharge (self, family member, professional in home, group home, LTC facility, rehabilitation hospital, other facility) -- VDU discharge for VDU cases, hospital discharge for UCDSS cases
Locomotion	need for assistance in locomotion (none, verbal cues, some physical help, substantial physical help, full dependence) at hospital discharge
Transferring	need for assistance in moving from chair to bed (same categories as for locomotion) at hospital discharge
Toileting	need for assistance in toileting (same categories as for locomotion) at hospital discharge
Bed Mobility	need for assistance in moving in bed (same categories as for locomotion) at hospital discharge
Eating	need for assistance in eating (same categories as for locomotion) at hospital discharge
RUGS III dependence index	an index of the patient's dependence on care by others at hospital discharge, based on the previous four variables
Expenditures (Medicare Part A, Medicare Part B, Total Part A and Total Part B)	
Hospital expenditures*	Expenditures during the entire period of the hospital stay associated with the ventilator episode
Daily hospital spending*	Expenditures per day during the entire period of the hospital stay associated with the ventilator episode
VDU expenditures	Expenditures during the VDU stay (VDU only and Part A only)
18-month daily spending**	Expenditures per day during the 18-month period beginning with the date of hospital admission
18-month spending per day alive**	Expenditures per day alive during the 18-month period beginning with the date of hospital admission

*Variable is censored for some observations.
**Based on data for less than 18 months for some observations.

transferring, and toileting are coded "1" if the patient required no more than queuing during the activity; "3" if the patient was highly involved in the activity but required nonweight bearing physical help; "4" if weight bearing assistance is provided and the "support provided" is no more than set up help; "5" if weight bearing assistance is provided and the "support provided" involves more than set up help. Eating is coded "1' if the patient required no more than cueing during the activity; "2" if the patient was highly involved in the activity but required non-weight

bearing physical help; and "3" if weight bearing assistance is provided or if the patient has a feeding tube.

The first nine of the 17 expenditure measures refer to the hospital stay. For all patients we examine expenditure for the full period of the stay and expenditure per day in four categories -- Medicare Part A, Medicare Part B, Total Part A (Medicare plus payments by the beneficiary or other insurance), and Total Part B -- for a total of eight variables. The ninth expenditure variable is for VDU patients only: Part A expenditures for the VDU stay. The last eight expenditure measures refer to the 18-month period that begins on the day of hospital admission, and includes expenditures during the hospital stay as well as post-discharge. For this period we measure expenditures *per day observed* and expenditures *per day alive* for each of the four expenditure categories. We examine expenditures per day observed, rather than total expenditures for the 18-month period, because the hospital episode occurred too recently to obtain claims data for the whole 18-month period in a substantial share of cases. For these cases, we collected data for as many days as were available.

Analyzing per day, or per day alive, expenditures, rather than total expenditures, is not sufficient to correct for variation in the length of the observation period. We expect mean expenditure per day to decline with days observed because every case has an expensive hospital stay at the beginning of the period, and because the longer we observe a group of cases, the higher is the share who are deceased and have no expenditures. We also expect mean expenditures per day alive to decline with days observed because the share of individuals who have a low expenditure subperiod probably increases with days observed. Hence, in the analysis we adjust for differences in the length of the period over which we were able to observe expenditures, in two other ways:

- When presenting descriptive statistics, we report means by number of days observed; and
- When estimating multivariate expenditure models for the 18-month period, we treat expenditures as censored if we observed claims for less than 18 months and the patient was alive at the end of the period for which we have claims.

The last two expenditure variables are Part A expenditures (total and Medicare) during the VDU stay, for VDU cases only. These expenditures are a subset of Part A expenditures for the hospital stay. We do not measure the corresponding Part B expenditures because Part B expenditures for the VDU period cannot be accurately distinguished from Part B expenditures for the enitre hospital stay.

A substantial number of patients exhausted their Part A inpatient benefits during their hospital stay, and some exhausted their Part A inpatient or SNF benefits during the post-discharge period. In these cases both total Part A and Medicare Part A expenditures for the relevant period are treated as censored in our multivariate analyses. As a result, coefficients should be interpreted as estimating the effect of the corresponding explanatory variables on expenditures if benefits are not exhausted.

B. Econometric Models

1. General Model Types

We estimate three types of multivariate econometric models: hazard, or survival, models; logit models; and regression models. The model type selected for an outcome variable depends on the nature of the data for the dependent variable. Hazard models are applied to the three clinical outcomes that are duration variables (LOS, LVE, VDU-LOS, and survival). Logit models are applied to categorical variables (discharge status, discharge destination, post-discharge caregiver). Regression models are applied to the RUGS III dependence index and all expenditure outcomes. If the expenditure variable is censored for some cases because Part A benefits are exhausted, we use a censored regression model. In some cases Part B expenditures are zero; we treat these cases as left-censored.

The specification of explanatory variables in all three types of models is fundamentally the same. We present this specification in the next subsection, then turn to more details on other aspects of model specification and estimation in the following section.

2. Specifications

All of the models we have estimated are of the following general form:

$$Y_i = f(VDU_i'\delta + R_i'\beta + E_i'\alpha + \sigma\varepsilon_i)$$

where:

- Y_i is the "dependent" (outcome) variable for case "i";
- f() is a function relating the dependent variable to the function's argument;
- VDU_i is a vector of four binary, "dummy" variables, indicating which VDU the case is from. Separate categories are included for Mayo pre-demonstration and Mayo demonstration patients. If all five values are zero, the case is a UCDSS case;
- δ is a vector of coefficients for the VDU dummies;
- R_i is a vector of variables to control for differences in risk;
- β is a vector of coefficients for the risk variables;
- E_i is a vector of "eligibility" variables;
- α is a vector of coefficients for the eligibility variables;
- σ is a scale parameter; and
- ε_i is an independent, identically distributed random disturbance.

Specific models vary in: the definition of the dependent variable, the function f(), assumptions about the random disturbance, the samples used to estimate them, and the exact specifications of the explanatory variables.

The coefficients of most interest are the coefficients of the VDU dummies. Each coefficient is proportional to the difference between the outcome for a case in the corresponding VDU and a UCDSS case with identical values for R_i, X_i, and ε_i.[2] They represent the best information we have on the clinical and expenditure impacts of the Demonstration.

The risk variables, R_i, are included to control for risk differences between UCDSS and VDU cases. They include a set of dummies to indicate which of many risk groups the case is from. The method we used for classifying cases into risk groups is described in Section II.C of this chapter. They also include a set of variables that are "external" to the classification of cases into risk groups, as discussed in Section II.D of this chapter. It is assumed that the effects of these external variables on outcomes are independent of which risk group a case is assigned to. While this assumption may be incorrect in some instances, the sample size is not large enough to explore interactions.

The eligibility variables, E_i, are included to control for differences in the extent to which patients were judged to satisfy the VDU admission criteria on Day 21 -- i.e., for the screening that was applied to VDU cases, but not to the UCDSS cases. Specification of these variables is problematic, so we tried two different approaches (see Section I.E, below).

2. Duration Models

For three of the five duration variables (LOS, LVE, VDU-LOS), we estimated "generalized gamma" duration models.[3] These models are a special case of a class of duration models known as "accelerated failure time" (AFT) models. This broader class of models assume that changes in the explanatory variables shift the hazard rate -- the probability that the episode will end ("fail") after a given duration conditional on lasting at least that long -- thereby accelerating failure.

All AFT models have the form:

$$ln(Y_i^*) = X_i'\beta + \sigma\varepsilon_i$$

$$ln(Y_i) = \max[ln(Y_i^*), ln(C_i)]$$

where Y_i^* is the duration of the episode, Y_i is observed duration, X_i is the vector of explanatory variables, β is the corresponding coefficient vector, C_i is the length of the observation period

---

[2] The "proportional to" terminology language is required because f() may be any monotonically increasing function. This can be seen as follows. According to the model, the difference between the outcome for a VDU case and the outcome for a UCDSS case with the same values for G_i, X_i, and ε_i is $\Delta Y = f(\delta_v + K) - f(K)$, where δ_v is the VDU coefficient for the particular VDU and K represents the factors held constant. The mean value theorem implies that $f(\delta_v + K) = f(K) + f'(K^*)\,\delta_v$, where f'() is the first derivative of f() and K^* is some value between K and $K + \delta_v$. Hence, $\Delta Y = f(\delta_v + K) - f(K) = f'(K^*)\,\delta_v$, and $f'(K^*)$ is the factor of proportionality.

[3] See Allison (1995).

for case i, beginning on the episode's start date, and *ln*() is the natural log function. If $Y_i = C_i$, the observation is said to be (right) censored.[4]

We initially tried to estimate gamma models for the other two duration variables, survival and post-discharge survival, but were not successful in obtaining convergence, even in very simple models. One of the parameters of the gamma model, known as a shape parameter, increased without apparent limit during the iterative estimation procedure, evidently trying to obtain a good fit for the relatively few cases with a very long survival. After trying several alternatives for solving this problem, we settled on estimating a logit model for mortality at hospital discharge (see below) and a Weibull duration model for post-discharge survival. The Weibull model is the special case of the generalized gamma model that is obtained by fixing the shape parameter at 1.0.[5]

3. Logit Models

We used logit models for modeling the categorical outcome variables (discharge status, discharge destination, discharge caregiver). We initially had planned to use logistic regression models, a more general version of the logit model for categorical outcome variables that have a meaningful order. We abandoned this plan, however, because many categories had too few observations within the category to estimate the model. Instead, we regrouped cases for each variable into two more highly aggregated categories and applied the standard logit model.

The logit model can be written as:

$$Y_i^* = X_i'\beta + \sigma\varepsilon_i$$

$$Y_i = 0 \text{ if } (Y_i^* < 0)$$

$$= 1 \text{ if } (Y_i^* > 0)$$

where: Y_i^* is an unobserved index variable; Y_i is the categorical variable; the disturbance, ε_i, has an "extreme value" distribution; and other variables are as previously defined. The logit regression model is one member of a class of models, defined by alternative specifications for the distribution of ε_i. The logit model is the most commonly used model from this family for

---

[4] "Left" censoring arises when the start date of the episode begins before the observation period. While we could include left censoring in the general specification, we omitted it because we do not use left censoring in the analysis. Some ventilator episodes are left-censored -- they began before hospital admission. We treat these cases as if they were not left-censored, but add one or more explanatory variables to capture pre-admission ventilator dependency to the models.

[5] We also tried the log normal model, for which the shape parameter is fixed at zero, but obtained a smaller value for the likelihood function -- not surprising given that the shape parameter under the gamma specification moved towards a positive value. The VDU dummy coefficients in each Weibull model were very similar to the non-converged coefficients from the corresponding gamma model. We also tried censoring survival for all cases living longer than 18 months at 18 months, on the theory that this would give less weight to the few cases that survived for several years, but the gamma model still did not converge.

computational reasons and because results obtained with the model are usually very close to those obtained with the second most commonly used specification, for which the disturbance is assumed to be normally distributed ("probit").

For the discharge status variable, we estimate two logit models. One is for whether the patient was alive at discharge, and the other is for whether the patient is weaned at discharge. For discharge destination, we estimate a model for whether the patient is discharged home or to another institution (usually a SNF). For post-discharge caregiver, we estimate a model for whether the patient's primary caregiver is either themself or another family member vs. a professional or institution.

The full sample was used to estimate discharge status models. For discharge destination and post-discharge caregiver we only used the sample of patients who were alive at discharge.

4. Regression Models

The RUGS III model and all of the expenditure models are multiple regression models. The dependent variable for the RUGS III model is the index value itself. For each expenditure model the dependent variable is the logarithm of the expenditure variable. Some of the expenditure variables are treated as censored for some observations because the patient's Medicare inpatient benefits were exhausted or because claims were not obtained for the full 18-month observation period and the patient was alive at the end of the period for which claims were observed.

All of the expenditure models fit the following censored regression specification

$$ln(Y_i^*) = X_i'\beta + \sigma\varepsilon_i$$

$$Y_i = Y_i^* \text{ if } 0 < Y_i^* < C_i^*$$

$$= 0 \text{ if } Y_i^* < 0$$

$$= C_i \text{ if } C_i < Y_i^*,$$

where Y_i is the observed expenditure variable, Y_i^* is what observed expenditure would be if it were not bounded on the left by zero and on the right by the exhaustion of Part A inpatient benefits, C_i is observed expenditure if the patient has exhausted Part A inpatient benefits, and all other variables are as defined previously. For expenditure variables with no censoring, this model reduces to the standard multiple regression model; Y_i and Y_i^* are identical for all observations. When censoring is present, the model is formally equivalent to the AFT model that we used for the duration variables (see Section I.C.2, above), but with left censoring adding. As with the duration variable models, we used the generalized gamma version of AFT

models.[6] In the absence of censoring, we only assume that the disturbance has a mean of zero and a standard deviation of one; no other distributional assumption is required to determine the properties of the estimators given our reasonably large samples.

C. Classification of Cases into Risk Groups

1. Background and Approach

We initially planned to classify both UCDSS and VDU cases into "risk groups" -- groups of patients that were relatively homogenous with respect to their condition on and before Day 21 -- on the basis of UCDSS and VDU clinical data. We discovered, however, that the quality of the UCDSS clinical data was inadequate for this purpose -- key classification variables were missing for a very large number of cases. Hence, we developed two sets of risk groups, one for VDU cases only and one for both VDU and UCDSS cases. The VDU risk groups are based on clinical data collected from the VDUs, following our original plan. We call the second set of risk groups, "claims-based" risk groups because they rely on diagnoses reported on Medicare claims. We adopted this strategy because the claims diagnoses for the two groups are directly comparable, but are believed to be less informative about risk than the clinical VDU data -- especially with respect to the clinical condition of the patient on Day 21.

We estimate models with VDU risk groups using only the VDU data, and estimate models with claims-based risk groups using the combined data. We are able to assess the adequacy of the claims-based risk groups to some extent by comparing the findings across VDUs from the two sets of estimates. If estimated differences across VDUs are very similar for the two specifications, we would have some confidence that use of the claims-based risk groups is a reasonable substitute for use of the VDU risk groups.

2. VDU Risk Groups

The scheme we developed for classifying VDU cases is displayed in Exhibit 5.2. The scheme was divised by using a combination of clinical judgment and examination of descriptive statistics. While the aim was to develop groups that were homogenous with respect to clinical condition at or before VDU admission, we also needed groups that were not extremely small.

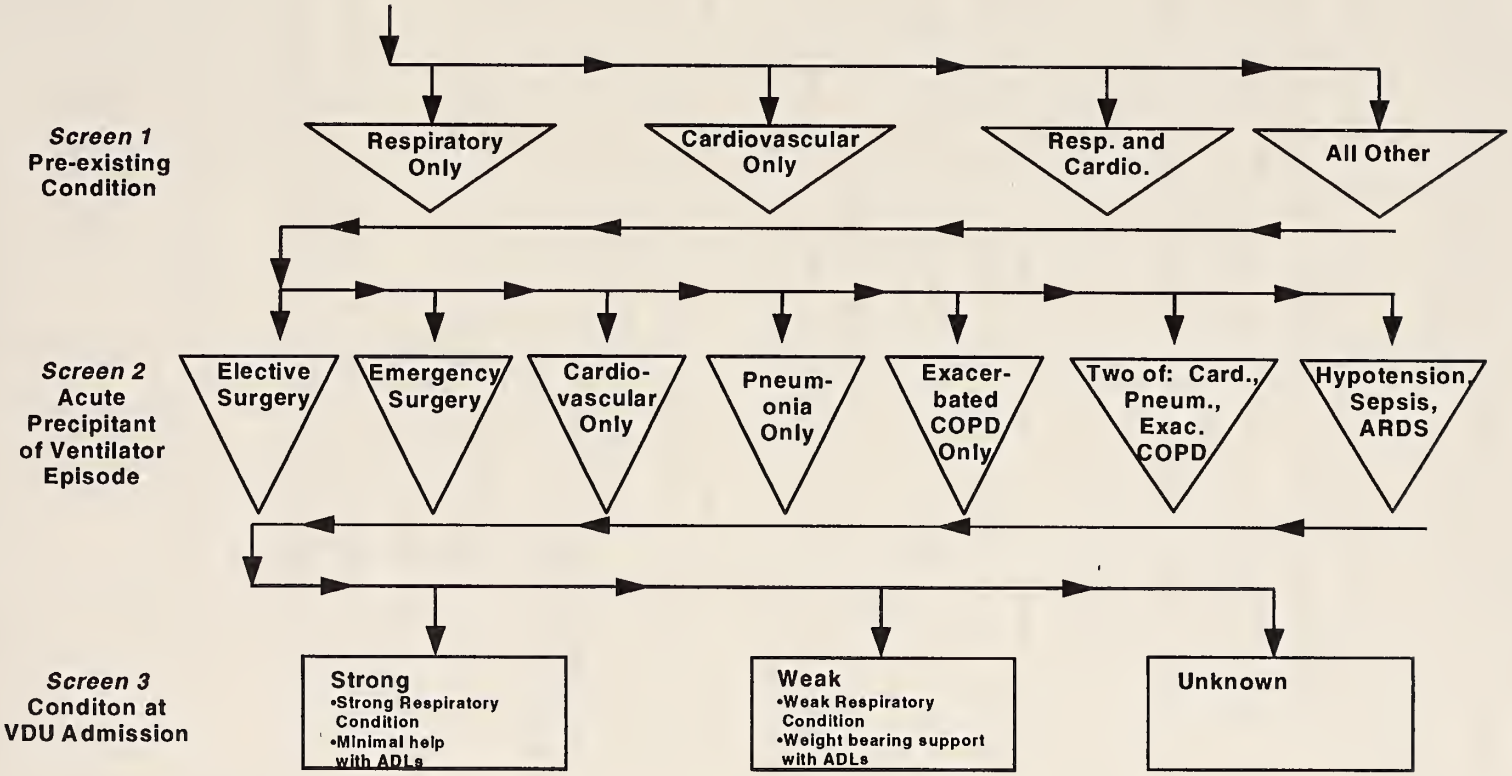
Under the scheme we developed, each case is passed through a series of three screens. At each screen, the case is "labeled" with a specific category for that screen. In some cases more than one label would apply, so for each screen we created a hierarchy of labels and applied the first label encountered (from left to right in the exhibit). Each VDU risk group is comprised of cases that ere assigned a common set of labels.

---

[6] The model we estimate can be viewed as a simple extension of a model known to economists as the "Tobit" model. If we assumed that the disturbance had a normal distribution, then the model we used would be the Tobit model in the logarithm of expenditures, with both left and right censoring. See Allison (1995).

Exhibit 5.2

VDU Risk Classification Scheme



The first screen is based on conditions that were pre-existing at the time the ventilator episode began (PXCs). A large majority of cases had a major pre-existing respiratory or cardiovascular condition, or both. There was substantial variety in PXCs among patients who had neither, but no subgroup of other pre-existing conditions had enough cases to justify a separate group.

The second screen is based on acute precipitants (APs) of the ventilator episode. A large number of cases were precipitated by surgery. We divided these into elective and emergency surgeries. Acute cardiovascular or respiratory conditions were the cause of most other cases. These were divided into four groups: cardiovascular only, pneumonia only, exacerbated chronic obstructive pulmonary disease (COPD) only, and at least two of the other three. The remaining cases were put in the residual group; APs in this group included hypotension, sepsis, and adult respiratory distress syndrome (ARDS).

The final screen is based on the patient's condition at VDU admission. We used three measures to assess whether they were "strong" or "weak" at admission. The first is a composite of the type of ventilator the patient uses, the number of hours of use, and the level of pressure support at use. The second is a measure of the patient's level of dependence in performing activities of daily living at admission. The third is the patient's FiO_2 level as a proxy for weaning potential. If their FiO_2 level was not available, their arterial oxygen level was used instead.

Patients score high on the first measure if they used intermittent mechanical ventilation (IMV) for no more than eight hours a day with no more than 10 breaths per minute of support. They receive a low score if they use an IMV for more than 8 hours a day or if they use assist control (AC) or continuous mechanical ventilation (CMV) ventilator, with more than 10 breaths per minute of support. Patients receive a high ADL score if on average they can perform activities with no more than nonweight bearing assistance. Patients receive a high score on the last measure if they have an FiO_2 level of less than 50 mm Hg_2 or, if that measure is missing, an arterial oxygen level of at least 60 mm Hg_2.

In general, patients are considered "weak" if they have a low score on two of the three measures, and "strong" if they have a high score on two of the three measures. There are several exceptions to this rule:

1. Some patients are neither strong nor weak based on the ventilator type/amount composite measure because they may appear weak by one factor and strong by another. If they score low on both of the other measures, they are scored as weak, and if they score high on both measures, they are scored as strong. If their scores on the ADL and weaning measures are not parallel, they are considered weak if they have more than eight hours of ventilator support per day, and strong if they have less.
2. Patients who have a low score on the weaning measurement (e.g., FiO_2=60) are always scored as "weak," except for those cases that fit into exception 1.

3. Patients who have a high score on the weaning measurement are considered "strong," except for those cases that fit into exception 1 and unless they have one of the following conditions at VRU admission: malignancy, cardiac arrest, ARDS, coma, stroke, or an albumin level less than or equal to 1.8 g/dL.

The outcomes from the first two levels of the screening process are described in Exhibit 5.3. While we had planned to use all three levels to fully cross-classify cases, we dropped this plan because many of the groups obtained after the first two screens were not very large. Instead, we use the third screen to create a second, separate categorical risk variable -- "Day 21 condition." Using the third screen in this way constrains the relationship between the screen and the outcome variable to be the same regardless of the risk category from the first two screens.

While there are 40 cells in the joint distribution of PXCs and APs, most cases fall into a small number of cells and 26 cells have four or fewer cases. Hence, we did not use a full set of 40 risk groups in the analysis. Instead, we used two categorical variables -- one for PXCs and one for APs -- and add three dummies to capture possible interactions between PXCs and APs for the three largest risk groups: both respiratory and cardiovascular PXCs with elective surgery; both respiratory and cardiovascular PXCs with emergency surgery; and cardiovascular PXC only with emergency surgery. These variables along with the Day 21 condition variable are included in all multivariate models using VDU data only unless otherwise noted.

Exhibit 5.3

VDU Risk Groups

Acute Precipitant	Pre-existing Condition					
	Respiratory	Cardiovascular	Resp. & Card.	All Other	None or Unknown	Total
Elective Surgery	7	10	34	5	1	57
Emergency Surgery	8	15	21	4	1	49
Hypotension, Sepsis, ARDS	5	2	13	1		21
Cardiovascular Only	1		8			9
Pneumonia Only	4	1	1	2		8
Exacerbated COPD Only	7	1	7			15
Two of Previous Three	6	2	7			15
Missing	9	4	4	4	16	37
All acute precipitants	47	35	95	16	18	211

3. Claims-based Risk Groups

The claims-based risk groups were derived from diagnostic information reported on Part A and Part B claims. As with the VDU risk groups, the objective was to establish groups that were reasonably homogeneous with respect to their medical condition on or before Day 21. In fact, however, we needed to limit the diagnoses used to those that were clearly known at or before hospital admission, namely the admission diagnosis itself and diagnoses from claims in the preceding 12-month period. We did not include other diagnoses from the hospital claim because we could not determine whether they applied before Day 21, or only later.

Based in part on our experience from developing the VDU risk groups and in part on examination of frequency distributions for diagnoses from the claims data, we classified cases into four pre-existing diagnosis categories (PDX: respiratory only, cardiovascular only, both respiratory and cardiovascular, and other) and six admitting diagnosis categories (ADX: respiratory surgery, cardiovascular surgery, other surgery, non-surgical respiratory, non-surgical cardiovascular, and all others).

The joint distributions of PDX and ADX for VDU and UCDSS cases appear in Exhibit 5.4. While there are 24 cells in the joint distribution for each group, most cases in both groups fall into just 10 cells. Almost all cases with an ADX of other surgery, non-surgical respiratory, non-surgical cardiovascular, or other had both cardiovascular and respiratory PDXs. Hence, we did not interact these three ADX categories with PDX, but instead put all cases within each of the three ADX categories into a single risk group. Similarly, almost all cases with an ADX of cardiovascular surgery had a PDX of either cardiovascular only or both respiratory and cardiovascular, so we divided cases within this ADX category into just two risk groups -- one for both cardiovascular and respiratory PDX and the other for all others (primarily cardiovascular only). For the respiratory surgery ADX category, there were enough cases in each of the four PDX categories to treat each as a separate risk group. In summary, we classified all cases into 10 claims-based risk groups, with some distinguished by ADX only because most had the same PDX, but with others distinguished by both ADX and PDX.

Another important feature of the distributions of PDX and ADX for VDU and UCDSS cases is that they are remarkably similar to one another. The marginal distributions of PDXs for the two groups are almost identical. About 56 percent of cases in both groups had both respiratory and cardiovascular PDXs, and about 28 percent had cardiovascular only PDXs. The marginal distributions for ADX are less similar -- relatively more VDU cases had respiratory surgery as their ADX, and relatively fewer had cardiovascular or other surgeries. For both groups, the cell with the largest share of cases is respiratory surgery ADX with both respiratory and cardiovascular PDX (31 percent of VDU cases and 25 percent of UCDSS cases).

Exhibit 5.4

Joint Distribution of Pre-existing and Admitting Diagnoses from Claims Data

Admitting Diagnosis	Group	Pre-existing Condition				
		Respiratory	Cardiovascular	Resp. & Card.	Other	Total
Respiratory Surgery	VDU	6.2%	14.2%	31.3%	3.8%	**55.5%**
	UCDSS	4.7%	14.5%	25.4%	2.2%	**46.9%**
Cardiovascular Surgery	VDU		5.7%	5.7%	1.0%	**12.3%**
	UCDSS	0.5%	6.7%	9.2%	0.8%	**17.2%**
Other Surgery	VDU	1.4%	1.9%	4.7%	1.0%	**9.0%**
	UCDSS	1.3%	2.5%	7.0%	2.0%	**12.7%**
Non-Surgical Respiratory	VDU	1.0%	1.0%	3.3%		**5.2%**
	UCDSS	1.3%	2.5%	4.5%	0.5%	**8.7%**
Non-Surgical Cardiovascular	VDU		2.8%	4.3%		**7.1%**
	UCDSS	0.3%	1.5%	3.7%		**5.5%**
Other	VDU	1.0%	1.9%	7.1%	1.0%	**10.9%**
	UCDSS	0.8%	1.3%	6.0%	1.0%	**9.0%**
Total	**VDU**	**9.5%**	**27.5%**	**56.4%**	**6.6%**	**100.0%**
	UCDSS	**8.7%**	**28.9%**	**55.9%**	**6.5%**	**100.0%**

*Based on 211 VDU cases and 401 UCDSS cases.

D. External Risk Variables

The external risk variables are variables that are hypothesized to be predictive of outcomes, but that were not used to define risk groups. The variables used are defined in Exhibit 5.5. All of these variables were available for both UCDSS and VDU cases.

Exhibit 5.5

External Risk Variables

Variable	Definition and Discussion
Age	Categorical variable with four groups: under 65, 65 - 74, 75 - 84, 85+
Sex	Categorical variable with two groups: female, male
Pre-hospital Part A Utilization	Categorical variable for existence of Part A claims during the 12 months prior to hospital admission, classified by type of claims found: hospital and SNF; hospital only or hospital with other non-SNF; home health only; other; and none. We found no cases with just SNF claims.
Locomotion ADL before Hospital Admission	Categorical activity of daily living measure for locomotion before hospital admission: dependent (requires weight bearing support or full staff performance); intermediate (requires queuing or supervision); independent (requires no help); or unknown
Pre-hospital Ventilator Dependence	Dummy variable to indicate that the patient was ventilator dependent prior to hospital admission

E. Eligibility Variables

Controlling for differences in the extent to which patients satisfy the VDU admission criteria is critical if patients who satisfy the criteria have lower risk for negative outcomes than those who don't, and if the risk variables don't adequately capture that risk. It is likely that both of these conditions are true, but measuring the extent to which patients satisfy the admission criteria is also very problematic, as evidenced in Chapter 4. Hence, we tried two approaches to controlling for differences in eligibility beyond inclusion of the risk variables discussed above.

In the first approach we simply included a categorical variable the eligibility groups that are described in Chapter 4 ("most," "substantial," "some," and "little or no" evidence of satisfying the admission criteria). Given the findings from the validation effort (see Chapter 4), our expectation is that this variable is unlikely to explain much of the variation in outcomes.

The second approach is the development of a measure of unobserved "luck," for patients who were admitted to the VDUs. A VDU patient is consider to be relatively "lucky" if the proportion of VDU cases in the patient's claims-based risk group is large relative to the proportion of UCDSS cases in the same risk group. The idea behind this measure is that the average VDU patient in a risk group that has low representation in the VDU sample relative to its representation in the UCDSS sample probably had relatively low risk among all patients in that risk category. The value of the measure is the same for all VDU patients within a risk

group. The value of the measure is zero for all UCDSS patients because we have no information about the luck of any UCDSS case in a risk group relative to any other UCDSS case in the risk group; all we are conjecturing is that the typical VDU case in a risk group is lucky relative to the typical UCDSS case in the same risk group. Given this reasoning, the coefficient on the luck variable is expected to be positive.[7]

The construction of the variable is somewhat complex. It also requires two assumptions that may be incorrect, and cannot be verified from our sample. The first assumption is that the VDU cases were selected from a population that has the same distribution of claims-based risk groups as found in the UCDSS sample. The second is that the cases in the risk group that has the greatest representation in the VDU sample relative to the group's representation in the UCDSS sample include all cases in the risk group in the population from which these cases were selected. The first of these assumptions is more critical than the second for the usefulness of the resulting variable.[8] Given these assumptions, construction of the "luck" variable proceeds as follows.

First, let p_r represent the proportion of both the UCDSS cases and the population of cases from which VDU cases were selected in risk group "r," let N_v represent the unknown size of the population from which VDU cases were selected, let n_v represent the size of the VDU sample, let a_r represent the unobserved share of group r cases in the population from which VDU cases that are also in the VDU sample, and let v_r represent the share of VDU cases that are in risk group r. Then:

$$v_r n_v = a_r p_r N_v.$$

Given the first of the two assumptions made above (i.,e., that p_r applies to both the UCDSS sample and the population from which the VDU cases were drawn), the only two unknowns in this equation are N_v and a_r. The equation can be inverted to obtain a_r apart from the multiplicative constant, N_v/n_v:

$$a_r^* = a_r(N_v/n_v) = v_r/p_r.$$

The factor of proportionality is determined by the second assumption, which is that the value of a_r for the risk group that has the largest value of a_r^* is 1.0.

Following the econometric literature on selection models, the "luck" variable is defined using the hazard function for the standard normal distribution. Let $\Phi()$ represent the

---

[7] A similar interpretation can be applied to the hazard ratio that is commonly included in regression models to control for selection effects.

[8] If the second assumption is wrong, but the first is right, the luck variable that we construct is a monotonic transformation of the variable we aim to construct. If the first assumption is wrong, there may be little relationship between the luck variable and the condition of a VDU patient relative to others in the same risk group from the underlying population. The reader familiar with the econometric literature on selection models may recognize why it is necessary to adopt assumptions such as these: we do not observe the size or characteristics of the population from which the VDU cases were selected.

cumulative distribution function for the standard normal distribution and let $\phi()$ represent the density function. Define z_r using the inverse distribution function, evaluated at a_r:

$$z_r = \Phi^{-1}(a_r).$$

The luck variable for group r is the hazard function for the standard normal distribution evaluated at z_r:

$$h_r = h(z_r) = \phi(z_r)/\Phi(z_r) = \phi(z_r)/a_r.$$

Henceforth, we refer to this eligibility variable as the hazard variable. The smallest value of the hazard variable is 0.0, when $a_r = 1.0$ (100 percent).[9] The value increases to 0.80 for $a_r = 0.5$, to 1.2 for $a_r = 0.25$, and to 2.1 for $a_r = 0.1$. For VDU cases, the value of the variable for each case is the calculated hazard for the case's risk group; for each UCDSS case the value of the variable is zero.

In principle we could apply this method separately to the cases from each VDU. This would be desirable given suspected differences in the way the units implemented the admission criteria, but is impractical given the relatively small sample sizes for each VDU.

Exhibit 5.6

Relative Percentages and Hazard Rates for Claims-based Risk Groups

Admitting Diagnosis	Variable	Pre-existing Condition: Respiratory	Cardiovascular	Resp. & Card.	All Other	Total
Respiratory Surgery	VDU%/UCDSS%	1.300	0.983	1.230	1.692	1.183
	Hazard	0.397	0.672	0.458	0.0**	
Cardiovascular Surgery	VDU%/UCDSS%		0.845	0.634		1.480
	Hazard		0.798	1.012		
Other Surgery	VDU%/UCDSS%			0.708		0.708
	Hazard			0.934		
Non-Surgical Respiratory	VDU%/UCDSS%			0.597		0.597
	Hazard			1.053		
Non-Surgical Cardiovascular	VDU%/UCDSS%			0.071		0.071
	Hazard			0.055		
Other	VDU%/UCDSS%			0.109		0.109
	Hazard			0.090		
Total	VDU%/UCDSS%	1.300	1.829	3.348	1.692	4.147

*Relative percentages based on joint distribution of pre-existing conditions and admitting diagnoses after shifting; see text.
**Normalization.

The values of the hazard variable for each of the 10 claims-based risk groups appear in Exhibit 5.6, along with the percent of VDU cases in each group relative to the percent of

[9] Technically, a_r cannot equal 1.0 for the standard normal distribution, but can only approach arbitrarily closely to 1.0, with the hazard approaching arbitrarily closely to 0.0.

UDCSS cases in the group (i.e., the values of a_i^*). The values range from the normalized value of zero for the group with an ADX of respiratory surgery and PDX of "other," to 1.05 for the group with ADX of cardiovascular surgery and PDX of both respiratory and cardiovascular.

II. DESCRIPTIVE STATISTICS

A. Clinical Outcomes

In this section we present and summarize descriptive statistics for the outcome variables. Clinical outcomes are examined in this subsection and expenditure outcomes are examined in the following subsection. It is important to keep in mind that differences across UCDSS and VDU cases, and across VDUs, may reflect differences in risk or differences in screening, as well as differences in patient care. In the last subsection, we compare descriptive statistics for the risk and eligibility variables across groups.

Clinical outcomes are summarized in Exhibit 5.7. In comparison to the typical UCDSS case, the typical VDU case had a substantially longer length-of-stay (median: 86 vs. 52 days, a difference of 34 days) and a much longer ventilator episode (median: 94 vs. 37 days, a difference of 57 days).[10] The typical VDU patient survived much longer, however, with the difference in median survival time being much larger than the differences for LOS and LVE (median: 258 days vs. 106 days, a difference of 152 days, or about five months). These differences are consistent with much lower in-hospital mortality for VDU cases (34 percent vs. 48 percent).

Differences in outcomes for patients who were alive at hospital discharge are similar in some respects, but in general are better for VDU cases. The median length of post-discharge survival for those alive at discharge is almost identical for the two groups -- 409 days for UCDSS cases and 407 days for VDU cases. Comparisons based on the categorical variables are difficult to interpret because of relatively high numbers of missing observations for the VDU cases. Although the share of living VDU patients who were identified as not ventilator dependent is smaller than the corresponding share of UCDSS patients when we include cases with missing information in the denominator (56 percent vs. 73 percent), the same shares for the two groups are essentially identical when missing cases are excluded from the calculation (74 percent for both).

[10] Note that median LVE for VDU cases exceeds median LOS for the same cases. The large value for LVE reflects the fact that LVE is considered to be censored if the patient is ventilator dependent at hospital discharge.

Exhibit 5.7

Unadjusted Clinical Outcomes

Variable		UCDSS	VDU					
			Total	Mayo		Mt. Sinai	RMS	Temple
				Demo.	Pre-demo.			
		All Cases						
Length of Hospital Stay (days)	75th percentile	75	119	81	101	156	120	121
	50th percentile (median)	52	86	60	63	121	94	85
	25th percentile	39	61	44	52	92	70	61
	Missing data	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Length of Ventilator Episode* (days)	75th percentile	53	147	107	97	**	148	129
	50th percentile (median)	37	94	60	80	114	104	76
	25th percentile	27	50	42	47	89	50	52
	Missing data	0.2%	2.8%	0.0%	0.0%	0.0%	3.5%	5.3%
Survival* (days)	75th percentile	493	713	1,261	1,299	280	381	924
	50th percentile (median)	106	258	509	1,152	168	170	312
	25th percentile	45	100	91	194	122	94	119
	Missing data	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Status at Hospital Discharge	Weaned	36.9%	38.4%	42.9%	53.3%	16.7%	32.6%	47.4%
	Ventilator dependent	13.7%	12.3%	5.7%	0.0%	16.7%	14.0%	15.8%
	fulltime	10.2%	2.8%	0.0%	0.0%	5.6%	4.7%	1.8%
	intermittent	2.2%	7.6%	5.7%	0.0%	11.1%	8.1%	8.8%
	unknown	1.2%	1.9%	0.0%	0.0%	0.0%	1.2%	5.3%
	Alive, vent. status unknown	1.0%	15.6%	31.4%	26.7%	16.7%	11.6%	8.8%
	Deceased	48.4%	33.6%	20.0%	20.0%	50.0%	41.9%	28.1%
	Missing data	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Sample Size		401	211	35	15	18	86	57
		Patients alive at hospital discharge						
Post Discharge Survival* (days)	75th percentile	594	1,111	1,221	1,345	503	584	865
	50th percentile (median)	409	407	528	1,112	273	242	407
	25th percentile	114	138	118	576	138	93	194
	Missing data	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Type of Ventilator at Discharge	None	71.5%	57.9%	53.6%	66.7%	33.3%	56.0%	65.9%
	Invasive	25.6%	15.7%	7.1%	0.0%	33.3%	24.0%	12.2%
	Non-invasive	1.0%	2.1%	0.0%	0.0%	0.0%	0.0%	7.3%
	Unknown Type	0.0%	0.7%	0.0%	0.0%	0.0%	0.0%	2.4%
	Missing data	1.9%	23.6%	39.3%	33.3%	33.3%	20.0%	12.2%
Discharge Destination	Home	27.5%	38.6%	53.6%	66.7%	55.6%	12.0%	48.8%
	LTC facility	51.2%	52.9%	39.3%	33.3%	33.3%	78.0%	41.5%
	Acute hospital	8.2%	7.1%	0.0%	0.0%	11.1%	10.0%	9.8%
	Missing data	12.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Post Discharge Caregiver	Self	2.9%	5.7%	14.3%	0.0%	11.1%	0.0%	7.3%
	Family	2.9%	17.9%	14.3%	8.3%	22.2%	18.0%	22.0%
	Prof. In H	11.1%	8.6%	7.1%	16.7%	11.1%	10.0%	4.9%
	Group Home	0.0%	1.4%	0.0%	0.0%	0.0%	0.0%	4.9%
	LTC	2.9%	1.4%	0.0%	8.3%	0.0%	0.0%	2.4%
	Rehab. Hos	19.8%	17.9%	21.4%	16.7%	0.0%	16.0%	22.0%
	Other Inst	50.2%	23.6%	7.1%	8.3%	22.2%	36.0%	24.4%
	Missing data	10.1%	23.6%	35.7%	41.7%	33.3%	20.0%	12.2%
Sample Size		207	140	28	12	9	50	41

*Corrected for censoring; censored observations are not counted as missing.
**Not estimated; more than 25 percent were ventilator dependent at hospital discharge.

VDU outcomes for those alive at discharge were clearly better than UCDSS outcomes, however, when other outcome variables are considered. When missing observations are included in the denominator, a larger share of VDU cases went home (34 percent vs. 27 percent) rather than to another institution, and a larger share were cared for by themselves or another family member (22 percent vs. six percent). The VDU percentages are also higher when missing observations are excluded from the denominator (34 percent vs. 31 percent for the share discharged to home, and 28 percent vs. seven percent for the share cared for by themselves or another family member). Based on reported ADLs, most patients who were alive at discharge required substantial physical assistance in performing these activities, but VDU patients less dependent than their UCDSS counterparts (Exhibit 5.8). About 18 percent of VDU cases had the best (lowest) possible RUGS III score of four, compared to just 11 percent of UCDSS cases. Another 19 percent of VDU cases and 18 percent of UCDSS cases had a score between five and ten. About 37 percent of UCDSS cases and 26 percent of VDU cases had a very high level of dependence, with RUGS III scores ranging from 15 to the highest possible value of 20. We were not able to calculate RUGS III scores for 20 percent of VDU and 19 percent of UCDSS because of incomplete data.

There were also substantial differences in clinical outcomes across VDUs. The overall picture is that clinical outcomes were substantially better for Mayo and Temple patients than for patients treated at Sinai and RMS. Outcomes for Mayo and Temple patients are very similar in most respects, with those for Mayo patients being somewhat better in most instances; outcomes for Sinai and RMS patients are similar in some respects and different in others, but comparisons are problematic because of the small sample size for Sinai. Further, outcomes for Sinai and RMS patients are not clearly better than those for UCDSS patients.

The discussion below refers only to outcomes for VDU patients during the demonstration period; i.e., pre-demonstration Mayo patients are ignored. Outcomes for these patients were, however, very similar to those for Mayo patients during the demonstration period.[11]

The median length-of-stay ranges from just 60 days at Mayo to 121 days at Sinai, with intermediate values for Temple (85) and RMS (94). The range for median length-of-ventilator episode is somewhat narrower, from a minimum of 60 days at Mayo to a maximum of 114 at Sinai. There are large differences in typical survival times; median survival time ranges from a high of 509 days at Mayo to a low of 168 days at Sinai. Median survival time for RMS cases is just two days longer than for Sinai cases, while median survival time for Temple cases is substantial longer, 312 days. Only 20 percent of Mayo cases and 28 percent of Temple cases

---

[11] An exception is that median survival time for the pre-demonstration patients is much greater for the demonstration cases. Not too much should be made of this because the sample size is very small. There is a big jump in survival times for pre-demonstration cases just before the median; the 46th percentile is 641, much closer to the median of 501 for the demonstration cases.

were identified as deceased at discharge, compared to 50 percent of Sinai cases and 42 percent of RMS cases.

For those alive at discharge, median post-discharge survival was much higher for Mayo and Temple cases (528 and 407 days, respectively) than for Sinai and RMS cases (273 and 242 days). About 66 percent of Temple patients who were alive at discharge had been weaned, compared to just over half of Mayo and RMS patients, and only one third of Sinai patients.

Differences in discharge destination of patients who were alive at discharge are striking. The percent who went home ranges from a high of 56 percent at Sinai to a low of 12 percent at RMS; the percentages for Mayo and Temple are between these extremes and almost identical (54 and 49, respectively). About 78 percent of RMS patients were sent to long-term care facilities, compared to about 40 percent for both Mayo and Temple and 33 percent for Sinai.

One-third of Sinai patients, 29 percent of Temple patients, and 28 percent of Mayo patients who were alive at discharge were taken care of by themselves or a family member; the corresponding percentage for RMS patients was only about half as large.[12]

Comparisons of functional status of patients at discharge are problematic because the share of cases with missing data varies across units. On the basis of the RUGS III index, it appears that the functional status of Mayo and Temple cases at discharge was similar, and better than the functional status of RMS and, especially, Sinai cases. About 24 percent of Temple cases were in the independent category, compared to 21 percent for Mayo, 10 percent for RMS, and none for Sinai. A significant share of cases in all units except for Mayo were in the most dependent category (15 to 20 points): 37 percent for Temple, 33 percent for Sinai, 28 percent for RMS, and just seven percent for Mayo.

When the outcomes for each VDU are compared to those for UCDSS cases, the outcomes for Mayo and Temple cases are substantially better than for UCDSS cases, but those for Sinai and RMS cases are not. In comparison to UCDSS cases, the percent of Sinai cases who were weaned at discharge is lower, the percent who were deceased is two points higher, the median post-discharge survival time of those discharged alive is 136 days lower, the percent discharged to home is 27 points higher, the percent who were cared for by themselves or another family member after discharge is 26 points higher, and functional status at discharge is very similar. For RMS cases, compared to UCDSS cases the percent who were weaned at discharge is about the same (depending on the status of cases with missing data), the percent who were deceased is six points lower, the median post-discharge survival time of

---

[12] One oddity in the figures for post-discharge caregiver and discharge destination is that 28 percent of RMS patients were reported as cared for by either a family member or a professional in the home, but only 12 percent were reported to have been discharged to home. We do not have an explanation of this apparent discrepancy.

Exhibit 5.8

Activity Limitations at Discharge

Variable		UCDSS	VDU					
			Total	Mayo		Mt. Sinai	RMS	Temple
				Demo.	Pre-demo			Demo.
Locomotion	independent	6.3%	23.6%	25.0%	50.0%	11.1%	14.0%	29.3%
	needs verbal ques	1.4%	26.4%	25.0%	8.3%	22.2%	38.0%	19.5%
	some physical help	24.2%	15.0%	7.1%	0.0%	0.0%	12.0%	31.7%
	substantial physical help	12.1%	10.7%	7.1%	8.3%	0.0%	16.0%	9.8%
	full dependence	27.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	missing data	28.5%	15.0%	35.7%	25.0%	44.4%	0.0%	9.8%
Transfering	independent	6.3%	32.1%	39.3%	41.7%	22.2%	24.0%	36.6%
	needs verbal ques	2.9%	7.9%	7.1%	8.3%	11.1%	8.0%	7.3%
	some physical help	28.5%	13.6%	7.1%	0.0%	0.0%	22.0%	14.6%
	substantial physical help	15.9%	15.0%	10.7%	25.0%	11.1%	12.0%	19.5%
	full dependence	21.7%	11.4%	0.0%	0.0%	22.2%	14.0%	17.1%
	missing data	26.1%	20.0%	35.7%	25.0%	33.3%	20.0%	4.9%
Toileting	independent	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	needs verbal ques	2.9%	5.7%	3.6%	8.3%	0.0%	6.0%	7.3%
	some physical help	17.9%	21.4%	14.3%	16.7%	22.2%	26.0%	22.0%
	substantial physical help	7.7%	15.0%	3.6%	16.7%	22.2%	20.0%	14.6%
	full dependence	29.0%	17.1%	3.6%	0.0%	22.2%	20.0%	26.8%
	missing data	32.4%	20.7%	39.3%	25.0%	33.3%	20.0%	4.9%
Bed Mobility	independent	22.2%	13.6%	10.7%	33.3%	0.0%	14.0%	12.2%
	needs verbal ques	2.9%	5.0%	10.7%	0.0%	0.0%	2.0%	7.3%
	some physical help	15.0%	30.0%	32.1%	16.7%	22.2%	34.0%	29.3%
	substantial physical help	7.7%	28.6%	10.7%	25.0%	33.3%	30.0%	39.0%
	full dependence	18.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	missing data	33.3%	22.9%	35.7%	25.0%	44.4%	20.0%	12.2%
Eating	independent	19.8%	14.3%	21.4%	33.3%	0.0%	4.0%	19.5%
	needs verbal ques	1.4%	8.6%	17.9%	0.0%	0.0%	6.0%	9.8%
	some physical help	13.5%	20.7%	14.3%	8.3%	11.1%	28.0%	22.0%
	substantial physical help	7.7%	18.6%	10.7%	25.0%	33.3%	22.0%	14.6%
	full dependence	27.5%	17.9%	0.0%	8.3%	22.2%	20.0%	29.3%
	missing data	30.0%	20.0%	35.7%	25.0%	33.3%	20.0%	4.9%
RUGS III Index	4 (independent)	11.1%	17.9%	21.4%	33.3%	0.0%	10.0%	24.4%
	5-9	17.9%	18.6%	25.0%	8.3%	11.1%	22.0%	14.6%
	10-14	15.0%	17.9%	10.7%	16.7%	22.2%	20.0%	19.5%
	15-18	37.2%	25.7%	7.1%	16.7%	33.3%	28.0%	36.6%
	Missing Data	18.8%	20.0%	35.7%	25.0%	33.3%	20.0%	4.9%
	n	207	140	28	12	9	50	41

those discharged alive is 167 days lower, the percent discharged to home is 15 points lower, the percent who were cared for by themselves or another family member after discharge is 12 points higher, the and functional status appears to be slightly better.

B. Expenditures

Medicare expenditures for the entire hospital stay were 35 percent higher for the average VDU case than for the average UCDSS cases: $123,000 vs. $91,000 (Exhibit 5.9). Part A expenditures account for about 90 percent of Medicare expenditures in both cases. The higher spending for VDU cases reflects the longer length of stays for VDU cases; Medicare expenditures per day for VDU cases were actually 16 percent lower than for UCDSS cases.

The difference between Medicare expenditures for UCDSS and VDU cases significantly understates the difference in total expenditures. While Medicare paid $32,000 more for the average VDU case than for the average UCDSS case, the difference in mean total expenditures is $46,000 (Exhibit 5.10), meaning that the beneficiary and other insurers paid an average of $14,000 more. The percentage difference for total expenditures is much larger than for Medicare expenditures (46 percent vs. 35 percent) because the coinsurance paid by Medicare beneficiaries and other insurers increases with length-of-stay. The difference between mean daily spending for UCDSS and VDU cases is somewhat smaller when total expenditures are considered rather than only Medicare expenditures; mean total expenditures per day are $252 higher for UCDSS cases, vs. $272 higher when just Medicare expenditures are considered.

When the 18-month period after hospital admission is considered, Medicare spending for VDU cases is 30 percent higher than spending for UCDSS cases, while total spending is about 32 percent higher. These percentages, which are based on mean expenditures per day for cases observed for 12 to 18 months, are somewhat lower than the analogous percentages for the hospital stay alone (35 and 48 percent).

The relatively high numbers for VDU cases partly reflect higher expenditures for the hospital stay, but also reflect the greater longevity of VDU cases post discharge. In fact, mean expenditures per day of life during the 18 months after admission are much lower for VDU cases than for UCDSS cases. Based on cases observed for at least 12 months, mean Medicare expenditures per day of life for VDU patients are 46 percent lower than for UCDSS patients ($761 vs. $1400), while mean total expenditures are 44 percent lower ($844 vs. $1,505).

Exhibit 5.9

Medicare Expenditures per Patient, Adjusted by Cost Index Only (FY1994 Dollars)

Variable	UCDSS	VDU					
			Mayo				
		Total	Demo.	Pre-demo.	Mt. Sinai	RMS	Temple
				Mean spending during hospital stay*			
Part A	$83,000	$111,000	$102,000	$88,000	$107,000	$131,000	$93,000
% Exhausting Part A	1.5%	9.5%	5.7%	0.0%	22.2%	14.0%	5.3%
Part B	$8,000	$12,000	$10,000	$6,000	$12,000	$9,000	$21,000
Total	$91,000	$123,000	$112,000	$94,000	$119,000	$140,000	$114,000
				Mean daily spending during hospital stay*			
Part A	$1,595	$1,334	$1,702	$1,135	$932	$1,461	$1,096
Part B	$145	$134	$156	$98	$106	$96	$228
Total	$1,740	$1,468	$1,858	$1,233	$1,038	$1,557	$1,324
				Mean daily spending up to 18 months after hospital admission*			
Part A all cases	**$189**	**$279**	**$216**	**$176**	**$260**	**$374**	**$207**
observed 6-12 mo.		$490			$422	$499	
observed 12-18 mo.	$189	$240	$216	$176	$214	$310	$207
Part B all cases	**$16**	**$26**	**$25**	**$15**	**$26**	**$24**	**$34**
observed 6-12 mo.		$17			$13	$17	
observed 12-18 mo.	$16	$27	$25	$15	$30	$27	$34
Total all cases	**$205**	**$305**	**$241**	**$191**	**$286**	**$397**	**$241**
observed 6-12 mo.		$507			$435	$516	
observed 12-18 mo.	$205	$267	$241	$191	$244	$337	$241
				Mean spending per day of life up to 18 months after hospital admission*			
Part A all cases	**$1,305**	**$738**	**$706**	**$318**	**$678**	**$1,039**	**$435**
observed 6-12 mo.	$0	$1,039	$0	$0	$760	$1,077	$0
observed 12-18 mo.	$1,305	$683	$706	$318	$655	$1,019	$435
Part B all cases	**$95**	**$70**	**$71**	**$28**	**$83**	**$69**	**$82**
observed 6-12 mo.	$0	$31	$0	$0	$30	$31	$0
observed 12-18 mo.	$95	$78	$71	$28	$98	$89	$82
Total all cases	**$1,400**	**$809**	**$777**	**$346**	**$761**	**$1,108**	**$517**
observed 6-12 mo.	$0	$1,069	$0	$0	$790	$1,108	$0
observed 12-18 mo.	$1,400	$761	$777	$346	$753	$1,108	$517
				Number of cases observed by length of observation period			
Part A all cases	401	211	35	15	18	86	57
observed 6-12 mo.	0	33	0	0	4	29	0
observed 12-18 mo.	401	178	35	15	14	57	57
Part B all cases	401	193	35	15	18	86	39
observed 6-12 mo.	0	33	0	0	4	29	0
observed 12-18 mo.	401	160	35	15	14	57	39

*"Hospital stay" refers to the hospital stay associated with the ventilator episode under study. Expenditures for the 18 months after admission also include expenditures in later stays.

Exhibit 5.10

Total Expenditures per Patient, Adjusted by Cost Index Only (FY1994 dollars)

Variable		UCDSS	VDU					
				Mayo				
			Total	Demo.	Pre-demo.	Mt. Sinai	RMS	Temple
		Mean spending during hospital stay* (thousands)						
Part A		$89,000	$131,000	$110,000	$90,000	$120,000	$145,000	$100,000
% Exhausting Part A		1.5%	9.5%	5.7%	0.0%	22.2%	14.0%	5.3%
Part B		$10,000	$14,000	$12,000	$8,000	$15,000	$11,000	$26,800
Total		$99,000	$145,000	$122,000	$98,000	$135,000	$156,000	$126,800
		Mean daily spending during hospital stay*						
Part A		$1,669	$1,430	$1,788	$1,161	$1,021	$1,598	$1,159
Part B		$183	$170	$196	$125	$132	$121	$287
Total		$1,852	$1,600	$1,984	$1,286	$1,153	$1,719	$1,446
		Mean daily spending up to 18 months after hospital admission*						
Part A	all cases	$206	$309	$236	$184	$295	$416	$228
	observed 6-12 mo.	$0	$546	$0	$0	$479	$555	$0
	observed 12-18 mo.	$206	$265	$236	$184	$242	$346	$228
Part B	all cases	$20	$32	$32	$20	$33	$29	$43
	observed 6-12 mo.	$0	$21	$0	$0	$17	$21	$0
	observed 12-18 mo.	$20	$34	$32	$20	$37	$33	$43
Total	all cases	$226	$341	$268	$204	$327	$445	$271
	observed 6-12 mo.	$0	$566	$0	$0	$496	$576	$0
	observed 12-18 mo.	$226	$299	$268	$204	$279	$379	$271
		Mean spending per day of life up to 18 months after hospital admission* (dollars)						
Part A	all cases	$1,386	$805	$787	$330	$752	$1,128	$471
	observed 6-12 mo.	$0	$1,129	$0	$0	$873	$1,164	$0
	observed 12-18 mo.	$1,386	$745	$787	$330	$718	$1,110	$471
Part B	all cases	$119	$88	$90	$35	$103	$87	$103
	observed 6-12 mo.	$0	$39	$0	$0	$38	$39	$0
	observed 12-18 mo.	$119	$99	$90	$35	$122	$111	$103
Total	all cases	$1,505	$893	$877	$365	$856	$1,215	$574
	observed 6-12 mo.	$0	$1,168	$0	$0	$911	$1,203	$0
	observed 12-18 mo.	$1,505	$844	$877	$365	$840	$1,221	$574
		Number of cases observed by length of observation period						
Part A	all cases	402	211	35	15	18	86	57
	observed 6-12 mo.	0	33	0	0	4	29	0
	observed 12-18 mo.	402	178	35	15	14	57	57
Part B	all cases	401	193	35	15	18	86	39
	observed 6-12 mo.	0	33	0	0	4	29	0
	observed 12-18 mo.	401	160	35	15	14	57	39

*"Hospital stay" refers to the hospital stay associated with the ventilator episode under study. Expenditures for the 18 months after admission also include expenditures in later stays.

There are also substantial differences in expenditures across the VDUs. One of the most striking differences is between Mayo cases in the pre-demonstration period and Mayo cases during the demonstration. Medicare expenditures were 19 percent higher for demonstration cases than for pre-demonstration cases and total expenditures were 24 percent higher. The increases are even larger on a daily basis: 51 percent for Medicare and 54 percent for total. While mean Medicare and total expenditures for Mayo cases during the demonstration period are lower than the corresponding means for any other unit, expenditures per day are higher than for any other unit. Another striking finding from comparison of expenditures across units is the high expenditures for RMS cases relative to those for patients in other VDUs. Mean Medicare and total expenditures for RMS cases are, respectively, 16 and 17 percent higher than the corresponding means for all VDU cases during the demonstration period (Exhibit 5.11). This is partly due to the relatively long lengths of stay for RMS cases; mean Medicare and total expenditures per day for RMS cases are, respectively, 10 and 5 percent higher than the corresponding means for all VDU cases during the demonstration period, and are substantially lower than the corresponding means for Mayo cases.

Part A expenditures for the hospital stay of VDU cases can be divided into expenditures for the VDU stay and those for the rest of the hospital stay (Exhibit 5.11). Mean Medicare and total expenditures for VDU cases during the non-VDU part of the hospital stay ($81,000 and 85,000) are very comparable to the corresponding means for UCDSS cases ($83,000 and $89,000) and also the corresponding means for Mayo pre-demonstration cases ($88,000 and $90,000), no doubt reflecting payments determined by the discharge DRG. On a daily basis, Medicare and total expenditures for VDU cases during the non-VDU part of the hospital stay ($2,308 and $2,388) are substantially higher than the corresponding means for UCDSS cases ($1,595 and $1,669) because the non-VDU portion of the average VDU patient's stay is shorter than the average UCDSS patient's stay.

Mean Medicare and total VDU expenditures vary substantially across the four units. The highest means are for RMS ($40,000 and $50,000, respectively), 74 and 100 percent higher, respectively, than those for Temple, the VDU with the lowest means ($23,000 and $25,000). This variation partly reflects variation in length-of-stay. Variation in Medicare and total expenditures per day is consequently smaller; the highest daily means are for Mayo ($943 for total and $860 for Medicare), which are 34 and 39 percent higher than the means for Temple, the VDU with the lowest means ($703 and $619).

Exhibit 5.11

VDU, Other, and Total Part A Expenditures During the Hospital Stay (FY1994 Dollars)

Variable	UCDSS	VDU					
			Mayo				
		Total*	Demo.	Pre-demo.	Mt. Sinai	RMS	Temple
Total Expenditures							
In VDU	n.a.	$38,358	$29,000	n.a.	$41,000	$50,000	$25,000
In Other Units	$89	$85,373	$81,000	$90,000	$79,000	$95,000	$75,000
Entire Stay	$89	$123,731	$110,000	$90,000	$120,000	$145,000	$100,000
Medicare Expenditures							
In VDU	n.a.	$31,865	$26,000	n.a.	$31,000	$40,000	$23,000
In Other Units	$83	$81,005	$76,000	$88,000	$76,000	$91,000	$70,000
Entire Stay	$83	$112,870	$102,000	$88,000	$107,000	$131,000	$93,000
Percent Exhausting Part A Benefits							
In VDU	n.a.	10.4%	2.9%	n.a.	22.2%	14.0%	5.6%
Entire Stay	1.5%	10.9%	5.7%	0.0%	22.2%	14.0%	5.6%
Total Expenditures per Day							
In VDU	n.a.	$824	$943	n.a.	$773	$862	$703
In Other Units	$1,669	$2,388	$2,947	$1,161	$1,218	$2,817	$1,733
Entire Stay	$1,669	$1,456	$1,788	$1,161	$1,021	$1,598	$1,159
Medicare Expenditures per Day							
In VDU	n.a.	$706	$860	n.a.	$629	$713	$619
In Other Units	$1,595	$2,308	$2,861	$1,135	$1,177	$2,719	$1,671
Entire Stay	$1,595	$1,353	$1,702	$1,135	$932	$1,461	$1,096
Sample Size	402	193	35	15	18	86	54

*Excludes Mayo pre-demonstration patients.
n.a. = not applicable

C. Descriptive Statistics for Risk and Eligibility Variables

1. Comparison of Risk and Eligibility Measures Across Groups

Descriptive statistics for the risk and eligibility variables appear in Exhibit 5.12. The outcome differences that were discussed in the previous section may in part be due to differences in these explanatory variables. We found remarkably small differences in the percentages and means for these variables for the UCDSS and VDU groups. Somewhat greater variation is found among the VDUs.

Exhibit 5.12

Descriptive Statistics for Risk and Eligibility Variables

Variable	UCDSS	VDU					
			Mayo				
		Total	Demo.	Pre-demo.	Mt. Sinai	RMS	Temple
Age							
under 65	13.5%	16.6%	2.9%	26.7%	44.4%	14.0%	17.6%
65 - 74	46.4%	42.2%	51.4%	33.3%	16.7%	41.9%	47.3%
75 - 84	34.4%	34.1%	37.1%	40.0%	33.3%	34.9%	29.8%
85+	5.7%	7.1%	8.6%	0.0%	5.6%	9.3%	5.2%
Sex							
female	52.1%	47.9%	34.3%	47.7%	57.0%	50.0%	42.1%
male	47.9%	52.1%	65.7%	52.3%	43.0%	50.0%	57.9%
Part A Claim in Prior Yr.							
hospital and SNF	5.0%	7.1%	2.9%	6.7%	11.1%	11.6%	1.8%
hospital	50.4%	49.3%	51.4%	60.0%	50.0%	37.2%	63.1%
home health	3.5%	3.8%	2.9%	0.0%	5.6%	5.8%	1.8%
other	21.0%	25.1%	31.4%	13.3%	16.7%	33.7%	14.0%
none	20.2%	14.7%	11.4%	20.0%	16.7%	11.6%	19.3%
Hospitalization in Prior Year							
mean inpatient days for those hospitalized	19	25	21	16	28	29	24
Vent. Use Before Hospital Admission							
dependent	0.2%	5.2%	8.6%	6.7%	5.6%	2.3%	7.0%
not dependent	99.8%	94.8%	91.4%	93.3%	94.4%	97.7%	93.0%
ADL Before Hospital Admission							
very dependent	8.7%	21.3%	17.1%	13.3%	33.3%	22.1%	21.1%
moderately dependent	14.0%	14.2%	11.4%	13.3%	5.6%	20.9%	21.1%
independent	55.9%	55.9%	71.4%	66.7%	50.0%	53.5%	49.1%
unknown	21.5%	8.5%	0.0%	5.6%	11.1%	3.5%	21.1%
Diagnoses in Prior Year							
respiratory	8.7%	9.5%	5.8%	26.7%	5.6%	11.6%	5.2%
cardiovascular	28.9%	27.5%	28.6%	26.7%	16.7%	15.1%	49.1%
resp. and card.	55.9%	56.4%	57.1%	26.7%	72.2%	68.6%	40.4%
other	6.5%	9.5%	8.6%	20.0%	5.6%	4.7%	5.2%
Admitting Diagnosis							
respiratory surgery	46.9%	55.5%	42.9%	26.7%	72.2%	55.8%	64.9%
cardiovascular surgery	17.2%	12.3%	22.9%	20.0%	0.0%	12.8%	7.0%
other surgery	12.7%	9.0%	17.1%	26.7%	5.6%	8.1%	3.5%
other respiratory	8.7%	5.2%	0.0%	6.7%	11.1%	9.3%	0.0%
other cardiovascular	5.5%	7.1%	2.9%	6.7%	11.1%	7.0%	8.8%
other	9.0%	10.9%	17.1%	13.3%	5.6%	7.0%	15.8%
Eligibility Group							
most evidence	0.8%	14.7%	31.4%	13.3%	44.4%	0.0%	17.5%
substantial evidence	16.7%	61.1%	60.0%	46.7%	33.3%	75.6%	52.6%
some evidence	44.9%	15.2%	28.6%	26.7%	0.0%	20.9%	15.8%
little or no evidence	37.7%	9.0%	5.7%	13.3%	22.2%	3.4%	14.0%
Pre-existing Condition							
respiratory only	n.a.	22.3%	14.3%	13.3%	16.7%	31.4%	17.5%
cardiovascular only	n.a.	16.6%	22.9%	20.0%	5.6%	11.6%	22.8%
resp. and card.	n.a.	45.0%	54.3%	66.7%	55.6%	37.2%	42.1%
other	n.a.	7.6%	2.9%	0.0%	16.7%	11.6%	3.5%
none or unknown	n.a.	8.5%	5.7%	0.0%	5.6%	8.1%	14.0%
Acute Precipitant							
elective surgery	n.a.	27.0%	25.7%	46.7%	5.6%	20.9%	38.6%
emergency surgery	n.a.	23.2%	45.7%	40.0%	5.6%	16.3%	21.1%
cardiovascular only	n.a.	4.3%	0.0%	6.7%	16.7%	2.3%	5.3%
pneumonia only	n.a.	3.8%	0.0%	0.0%	0.0%	9.3%	0.0%
exacerbated COPD only	n.a.	7.1%	2.9%	6.7%	11.1%	11.6%	1.8%
two of previous three	n.a.	7.1%	5.7%	0.0%	0.0%	14.0%	1.8%
sepsis, ARDS, or hypotension	n.a.	10.0%	14.3%	0.0%	22.2%	10.5%	5.3%
other or unknown	n.a.	17.6%	5.7%	0.0%	38.9%	15.2%	26.3%
Condition at VDU Admission							
strong	n.a.	34.6%	31.4%	26.7%	44.4%	48.8%	14.0%
weak	n.a.	43.6%	37.1%	46.7%	50.0%	50.0%	35.1%
missing	n.a.	21.8%	31.4%	26.7%	5.6%	1.2%	50.9%
Hazard Ratio							
mean	n.a.	0.59	0.61	0.68	0.51	0.63	0.54
Sample Size	401	211	35	15	18	86	57

The age distributions for the UCDSS and VDU cases are very similar; 41 percent of UCDSS cases are 75 or over compared to 42 percent of VDU cases, and the share of VDU cases under the age of 65 is also slightly higher (17 percent vs. 14 percent). Approximately half of each group's cases are of each sex. The distributions of Part A claims in the prior year are very similar, with a somewhat larger percentage of UCDSS cases having no claims. About five percent of VDU cases were ventilator dependent before hospital admission, compared to less than one percent for UCDSS cases. Perhaps the most substantial difference between the two groups is that a larger share of VDU cases were very dependent on assistance from others before hospital admission (21 percent vs. 9 percent). The admitting diagnosis was more likely to be respiratory surgery for VDU cases than for UCDSS cases, but less likely to be cardiovascular surgery. As discussed in Chapter 4, based on the eligibility group variable the VDU cases showed more evidence of satisfying the VDU admission criteria than the UCDSS cases. Overall, there is little clear indication that the VDU cases are at higher or lower risk of poor outcomes than the UCDSS cases.

The somewhat greater variation in means and percentages across the VDUs is not surprising given the smaller samples and the dissimilarities among the VDUs and their locations. The following are some particularly large deviations from the means and percentages for all VDU cases, but are not necessarily of any importance:

- About 44 percent of Sinai patients were under 65, compared to 17 percent for all VDU cases;
- Almost two-thirds of the Mayo cases during the demonstration period were women, compared to 48 percent over all;
- Only two percent of Temple patients and three percent of Mayo patients had a Part A SNF claim in the previous year, compared to 11 percent for Mt Sinai and 12 percent for RMS;
- Only 12 percent of Sinai cases had an acute precipitant of surgery (emergency and elective combined), compared to 39 percent for all VDU cases combined. Note, however, that Sinai also had a large share of cases with "other or unknown" as their acute precipitant; and
- Only 14 percent of Temple cases were judged to be "strong" at VDU admission, compared to 35 percent for all VDU cases. Note, however, that the percent of Temple cases with missing data for this variable is large.

We also found that the mean hazard ratio varies little across the groups, from a low of 0.51 for Sinai to a high of 0.63 for RMS.

2. The Relationship between Risk and Eligibility Variables and Mortality at Discharge

Examination of percentages and means for the risk and eligibility variables and discharge mortality reveals few relationships that are strong and consistent for both UCDSS and VDU cases (Exhibit 5.13). It should be kept in mind that these are univariate relationships, and are not necessarily causal. We found:

- *Those age 75 or over at hospital admission were much more likely to be deceased at discharge than those who were younger.* This is the strongest relationship we found, and the most consistent across the two groups. About 43 percent of UCDSS cases who were deceased at discharge were 75 or older, compared to 37 percent for those who were alive, and this relationship is stronger for VDU cases; the corresponding values for VDU cases are 53 percent and 35 percent.
- *Those with Part A hospital claims in the prior year were more likely to be deceased at discharge.* About 67 percent of UCDSS cases who were deceased at discharge had a Part A hospital claim in the prior year compared to 53 percent of cases who were alive at discharge, but this relationship is much weaker for VDU cases; the corresponding values for VDU cases are 58 and 56 percent ;
- *Those who were classified as independent prior to admission by the ADL measure were less likely to be deceased at discharge.* For UCDSS cases 49 percent of those who were deceased at discharge were classified as independent compared to 63 percent of those who were alive. The comparable figures for VDU cases are 54 percent and 57 percent; and
- *Those whose admitting diagnosis was either respiratory or cardiovascular surgery were more likely to be deceased at discharge.* For UCDSS cases, 66 percent of those who were deceased at discharge had either respiratory or cardiovascular surgery, compared to 62 percent of those who were discharged alive. The comparable figures for VDU cases are 71 percent and 67 percent.

Some significant relationships between mortality and VDU risk variables were also found, but could not be verified for the UCDSS data:

- *Those who had both respiratory and cardiovascular PXCs were more likely to be deceased at discharge*; 54 percent of those deceased at discharge were in this category, compared to 41 percent for those who were alive. Mortality was also higher among those with only a cardiovascular PXC, and much lower among those with only a respiratory or some other PXC;
- *Those whose AP was elective surgery were less likely than others to be deceased at discharge.* Of those deceased at discharge, 23 percent were in this category, compared to 29 percent of those who were alive; and

Exhibit 5.13

Relationship between Discharge Mortality and Descriptive Statistics for Risk and Eligibility Variables

Variable	UCDSS		VDU	
	Alive	Deceased	Alive	Deceased
Age				
under 65	13.5%	13.4%	17.9%	14.1%
65 - 74	49.3%	43.3%	47.1%	32.4%
75 - 84	33.3%	35.6%	30.0%	42.3%
85+	3.9%	7.7%	5.0%	11.3%
Sex				
female	52.7%	51.6%	50.7%	42.3%
male	47.3%	48.5%	49.3%	57.8%
Part A Claim in Prior Yr.				
hospital and SNF	3.9%	6.2%	5.7%	9.9%
hospital	49.3%	51.6%	50.0%	47.9%
home health	2.4%	4.6%	2.9%	5.6%
other	24.6%	17.0%	25.0%	25.4%
none	19.8%	20.6%	16.4%	11.3%
Hospitalization in Prior Year				
mean inpatient days for those hospitalized	18	20	24	27
Vent. Use Before Hospital Admission				
dependent	0.0%	0.5%	6.4%	2.8%
not dependent	100.0%	99.5%	93.6%	97.2%
ADL Before Hospital Admission				
very dependent	7.7%	9.8%	20.0%	23.9%
moderately dependent	11.6%	16.5%	12.9%	16.9%
independent	62.3%	49.0%	57.1%	53.5%
unknown	18.4%	24.7%	10.0%	5.6%
Diagnoses in Prior Year				
respiratory	10.6%	6.7%	10.0%	8.5%
cardiovascular	25.6%	32.5%	31.4%	19.7%
resp. and card.	57.5%	54.1%	52.1%	64.8%
other	6.3%	6.7%	6.4%	7.0%
Admitting Diagnosis				
respiratory surgery	42.0%	52.1%	52.9%	60.6%
cardiovascular surgery	19.8%	14.4%	13.6%	9.9%
other surgery	13.0%	12.4%	10.0%	7.0%
other respiratory	10.1%	7.2%	5.0%	5.6%
other cardiovascular	4.8%	6.2%	7.9%	5.6%
other	10.1%	7.7%	10.7%	11.3%
Eligibility Group				
most evidence	1.0%	0.5%	14.3%	15.5%
substantial evidence	16.9%	16.5%	61.4%	60.6%
some evidence	48.8%	40.7%	12.9%	19.7%
little or no evidence	33.3%	42.3%	11.4%	4.2%
Pre-existing Condition				
respiratory only	n.a.	n.a.	26.4%	14.1%
cardiovascular only	n.a.	n.a.	14.3%	21.1%
resp. and card.	n.a.	n.a.	40.7%	53.5%
other	n.a.	n.a.	9.3%	4.2%
none or unknown	n.a.	n.a.	9.3%	7.0%
Acute Precipitant				
elective surgery	n.a.	n.a.	28.6%	23.9%
emergency surgery	n.a.	n.a.	23.6%	22.5%
cardiovascular only	n.a.	n.a.	3.6%	5.6%
pneumonia only	n.a.	n.a.	3.6%	4.2%
exacerbated COPD only	n.a.	n.a.	7.9%	5.6%
two of previous three	n.a.	n.a.	6.4%	8.5%
sepsis, ARDS, or hypotension	n.a.	n.a.	8.6%	12.7%
other or unknown	n.a.	n.a.	17.9%	16.9%
Condition at VDU Admission				
strong	n.a.	n.a.	42.1%	36.6%
weak	n.a.	n.a.	45.0%	53.5%
missing	n.a.	n.a.	12.9%	9.9%
Hazard Ratio				
mean	n.a.	n.a.	0.61	0.56
Sample Size	207	194	140	71

- *Those whose condition at VDU admission was classified as strong were less likely than others to be deceased at discharge.* Of those deceased at discharge, 37 percent were in the strong category, compared to 42 percent of those who were alive.

III. FINDINGS FROM MULTIVARIATE ANALYSES

A. Introduction

In the following two subsections we summarize our findings from the multivariate analyses using both UCDSS and VDU cases (Subsection B) and from using VDU cases alone (Subsection C). The summaries focus on differences among groups after adjusting for the control variables -- UCDSS vs. each of the VDUs in Subsection B and among the VDUs in Subsection C. We report estimated differences between groups for each outcome variable both before and after adjusting for the control variables. The differences reported are derived directly from the coefficients of the VDU dummy variables in the multivariate models.

Full results for each model summarized here are reported in the appendix. Before turning to the comparisons of adjusted outcomes, we briefly summarize our findings with respect to the importance of the control variables.

Overall, the explanatory power of the control variables was not very high. In fact, as shown in the exhibits in the following sections, for some models we could not reject the null hypothesis that all control variables had zero coefficients by a likelihood ratio (LR) test. As a rule, the control variables were more successful at explaining variation in expenditures than variation in clinical outcomes. We did not drop variables because of low explanatory power in any individual equation because our focus is on the coefficients of the VDU dummies; we decided it was better to err on the side of including a variable, at the risk of lower estimator efficiency, than to exclude it and potentially bias a VDU dummy coefficient.

All variables were significant in some equations, and signs coefficient signs were generally consistent with expectations. Over all models, the eligibility group variable was the most consistently significant variable. We found that the hazard variable did not have significant coefficients when it was used instead of the eligibility group variable, and it was excluded from the models that we are reporting on. The age variable was frequently significant, with those age 85 and over having poorer clinical outcomes and lower expenditures. Sex was rarely significant. A hospital stay in the previous year was a significant negative predictor of some clinical outcomes, but other Part A utilization in the previous year was not. The locomotion ADL at admission variable was also significant in a number of equations, with those who were independent at admission having better clinical outcomes.

The VDU-only risk variables had substantial explanatory power in predicting weaning, and in predicting VDU length-of-stay and VDU expenditures, but were not as successful in predicting other outcomes. Of these variables, only the pre-existing condition categories had explanatory power in the hospital mortality equation and only the acute precipitant categories had explanatory power in the length-of-stay equation. The Day 21 condition variable had predictive power in several of the expenditure models, but in the clinical models was only significant in the discharge destination equation. The claims-based risk groups were rarely significant in the clinical models, but were frequently significant in the expenditure models.

We used different control variables in the equations for post-discharge survival and length of VDU stay. In the post-discharge survival model we included age, sex, the length of the hospital stay, ventilator status at discharge, the RUGS-III index, discharge destination, and post-discharge caregiver. Of these, only the RUGS-III index and post-discharge destination had substantial predictive power.

In the VDU length-of-stay model, which was estimated with only VDU data, we added one variable to the variables included in the other VDU-only models -- logarithm of the hospital length-of-stay prior to VDU admission. We included this variable because we knew that many transfer patients, especially at RMS, had ICU stays before VDU admission that were much longer than those for other patients. This variable turned out to be insignificant.[13]

B. Differences between Demonstration Units and Comparison Group

Key results from the estimation of the clinical models using both VDU and UCDSS cases appear in Exhibits 5.14 (clinical outcomes) and 5.15 (expenditure outcomes). The base group in these results is UCDSS cases. For each outcome variable we show the unadjusted difference in outcomes (each VDU minus UCDSS) and an adjusted difference -- one that holds constant the risk and eligibility variables in the model. We also show the p-value for the estimated difference, the p-value for the likelihood ratio test of the hypothesis that all of the control variables have zero coefficients, the type of econometric model used in the analysis, and a model reference number, to be used for finding the full set of results for the model in the appendix.

1. Clinical Outcomes

We found statistically significant differences between VDU outcomes and UCDSS outcomes both before and after adjusting for the control variables for all outcome variables except survival post discharge for those who were alive at discharge (Exhibit 5.14). Although the average VDU patient who was alive at discharge had longer post-discharge survival than the average UCDSS case, the difference was not statistically significant. The lack of

---

[13] Full results for all models summarized in the following tables appear in the appendix.

significance for this variable reflects both the high variability of the duration of post-discharge survival, and the substantial share of cases that were still alive when last observed.

Adjusted differences in outcomes tended to be larger than unadjusted differences, although not uniformly so. That is controlling for risk and eligibility tended to increase, rather than reduce, outcome differences.

Although VDU outcomes overall were significantly better than UCDSS outcomes, this statement is not true for all individual units. Outcomes for Mayo and Temple cases were clearly better, on average, than those for UCDSS cases both before and after adjusting for the control variables, but those for Sinai and RMS cases were not.

For Mayo cases (during the demonstration period), the percent of patients who were weaned at discharge was much higher than for UCDSS cases (by 30 percentage points after adjusting for the control variables), and the percent alive at discharge was much higher (by 31 percentage points after adjustment). For those alive at discharge, the percent cared for by themself or a family member was much higher (by 51 points after adjustment), the percent discharged home was much higher (by 32 points after adjustment), and the mean value of the RUGS III index was lower (by 5.6 points after adjustment). The average Mayo case had a longer hospital stay (LOS) than the average UCDSS case (17 percent longer after adjustment), but the difference was only marginally significant. Findings for the Mayo pre-demonstration cases are similar.

Mean hospital LOS was substantially longer for Temple cases than for UCDSS cases (68 percent after adjustment). A larger share of Temple cases were weaned at discharge (by 19 percentage points after adjustment) and were alive at discharge (by 25 points after adjustment). Of those discharged alive, a larger share were cared for by themself or a family caregiver (by 26 points after adjustment). Although the adjusted mean of the RUGS III index is lower for Temple cases than for VDU cases, the difference is not statistically significant.

For Sinai cases, the only significant differences we found were for length of stay (132 percent longer for Sinai cases than for UCDSS cases after adjusting for the control variables), the percent of those discharged alive who were cared for by themself or a family member after discharge (57 percentage points higher after adjustment), and the percent of those discharged alive whose destination was home (23 percentage points higher after adjustment). Lack of significant differences for Sinai cases reflects, in part, the small sample size for that unit.

Sample size is not an issue for RMS, but as with Sinai cases we found few significant differences between RMS outcomes and UCDSS outcomes. Length of stay for RMS cases is longer (80 percent longer after adjusting for the control variables), and the percent of those discharged alive who are cared for by themself or a family member is higher (by 23 percentage points after adjustment).

Exhibit 5.14

Summary of Results for Clinical Models Using VDU and UCDSS Cases

Dependent Variable, Model Type, and Model Number	Difference between VDU and UCDSS					UCDSS Mean or Percent	LR Test* p-value	n
	Mayo							
	Demo.	Pre-demo.	Mt. Sinai	RMS	Temple			
Length of Hospital Stay (duration)			percent difference					
1.1 with control variables**	16.6%	34.7%	131.8%	79.9%	67.8%		0.198	612
	(0.074)	(0.009)	(0.000)	(0.000)	(0.000)	60.5		
1.2 without control variables	11.5%	32.0%	122.5%	68.6%	57.6%			
	(0.157)	(0.015)	(0.000)	(0.000)	(0.000)			
Weaned at Discharge (logit)			percentage point difference					
2.1 with control variables**	30.0	35.4	-13.2	5.4	18.9	37.3%	0.333	564
	(0.018)	(0.050)	(0.398)	(0.661)	(0.029)			
2.2 without control variables	24.8	35.1	-17.6	-0.8	15.3			
	(0.019)	(0.030)	(0.177)	(0.893)	(0.038)			
Alive at Discharge (logit)			percentage point difference					
3.1 with control variables**	31.2	26.8	5.0	6.3	25.1	51.6%	0.136	612
	(0.003)	(0.076)	(0.720)	(0.384)	(0.002)			
3.2 without control variables	28.5	28.5	-1.4	6.8	20.5			
	(0.002)	(0.042)	(0.909)	(0.255)	(0.004)			
Self or Family Caregiver at Discharge (logit)			percentage point difference					
4.1 with control variables**	50.5	18.8	57.4	22.8	25.5	6.5%	0.741	344
	(0.000)	(0.246)	(0.005)	(0.003)	(0.001)			
4.2 without control variables	40.7	9.2	46.2	18.0	29.3			
	(0.000)	(0.379)	(0.001)	(0.001)	(0.000)			
Discharge RUGSIII Index (regression)			difference in RUGSIII points					
5.1 with control variables**	-5.90	-5.21	-1.16	0.89	-0.92	12.5	0.146	280
	(0.001)	(0.002)	(0.163)	(0.648)	(0.308)			
5.2 without control variables	-4.69	-3.47	-0.65	1.36	-1.47			
	(0.000)	(0.042)	(0.461)	(0.510)	(0.097)			
Discharged to Home (logit)			percentage point difference					
6.1 with control variables**	31.6	44.5	22.7	-19.7	16.2	31.5%	0.079	320
	(0.020)	(0.016)	(0.023)	(0.235)	(0.138)			
6.2 without control variables	21.9	35.0	23.9	-19.6	17.1			
	(0.027)	(0.021)	(0.008)	(0.150)	(0.040)			
Survival Post Discharge (duration)			difference in days survived					
7.1 with control variables**	52.8%	129.3%	-12.6%	-12.1%	53.1%	403	0.008	347
	(0.182)	(0.024)	(0.778)	(0.618)	(0.109)			
7.2 without control variables	59.7%	135.1%	-43.3%	-31.9%	37.0%			
	(0.092)	(0.016)	(0.175)	(0.088)	(0.137)			

Numbers in parentheses are p-values for the hypothesis of "no difference."

*Statistic reported is p-value for likelihood-ratio (LR) test of hypothesis that all coefficients of control variables are zero.

**Control variables are risk groups based on claims data, age, sex, type of Part A claim in previous 12 months, ventilator dependence before hospital admission, functional dependence at admission, and eligibility group.

***Percentage point difference shown in table is for percent discharged to home.

2. Expenditures

Findings from the expenditure models using both UCDSS and VDU cases are summarized in Exhibit 5.15.[14] Overall, we found that total expenditures were significantly higher for VDU cases than for UCDSS cases, both before and after adjusting for the control variables. This statement applies to both Part A and Part B expenditures, and to both total and Medicare expenditures. Expenditures per day alive, however, were significantly lower for VDU cases from some of the units.

As with the clinical findings, results varied substantially across units. The smallest increases in expenditure and the largest reductions in expenditure per day alive were found for Mayo and Temple cases; expenditure increases for Sinai and RMS cases were much larger, and reductions in expenditure per day alive were much smaller.

For Mayo cases (during the demonstration period), Part A expenditures were from 15 to 21 percent higher than for UCDSS cases, depending on the measure used) after adjusting for the control variables. Part B expenditures during the hospital stay are about 18 percent higher than for UCDSS cases; for the 18-month period they are about 55 percent higher, reflecting the much greater longevity of the average Mayo case. Expenditures per day alive in the 18 month period are from 31 to 47 percent lower than for UCDSS cases, depending on the measure.

For Temple cases, Part A expenditures are only 8 to 16 percent higher than for UCDSS cases, depending on the measure used, after adjusting for the control variables. Part B expenditures are much higher -- 143 percent higher during the hospital stay and 185 percent higher for the 18-month period. We do not have an explanation for the disparity in the Part A and Part B results. While the Part B difference is very large in percentage terms, it contributes relatively little to differences in combined Part A and Part B expenditures; as will be seen more clearly in the discussion of the findings from the VDU-only models, overall expenditures for Temple cases after adjusting for the control variables are much lower than those for Sinai and RMS cases, and about the same as those for Mayo demonstration cases. Part A expenditures per day alive in the 18-month period are from 49 to 63 percent lower for Temple cases than for UCDSS cases, while for Part B they are about 13 percent higher.

---

[14] When comparing the findings for the expenditure models to the descriptive statistics for expenditures in Exhibits 5.9 through 5.11, it should be kept in mind that the results in Exhibit 5.15 have been adjusted for censoring, whereas those in Exhibits 5.9 through 5.11 have not.

Exhibit 5.15

Summary of Results for Expenditure Models Using VDU and UCDSS Cases

Dependent Variable, Model Type, and Model Number	Difference between VDU and UCDSS					UCDSS Mean	LR Test* p-value	n
	Mayo							
	Demo.	Pre-demo.	Mt. Sinai	RMS	Temple			
Medicare Part A Expenditures During Hospital Stay (censored regression)* **								
8.1 with control variables**	15.3%	27.6%	36.6%	70.7%	8.5%	$83,000	0.000	612
	(0.040)	(0.030)	(0.001)	(0.000)	(0.144)			
8.2 without control variables	22.4%	16.1%	32.0%	63.2%	14.1%			
	(0.002)	(0.116)	(0.004)	(0.000)	(0.011)			
Medicare Part B Expenditures During Hospital Stay (censored regression)								
9.1 with control variables**	17.7%	-9.2%	55.4%	30.9%	142.8%	$8,000	0.000	594
	(0.197)	(0.521)	(0.007)	(0.001)	(0.000)			
9.2 without control variables	10.5%	-15.8%	28.5%	8.5%	128.4%			
	(0.374)	(0.302)	(0.101)	(0.279)	(0.000)			
Total Part A Expenditures During Hospital Stay (censored regression)								
10.1 with control variables**	20.0%	15.7%	47.2%	75.1%	12.5%	$89,000	0.000	612
	(0.001)	(0.049)	(0.291)	(0.091)	(0.001)			
10.2 without control variables	23.2%	5.9%	40.8%	68.1%	13.7%			
	(0.002)	(0.556)	(0.000)	(0.000)	(0.015)			
Total Part B Expenditures During Hospital Stay (censored regression)								
11.1 with control variables**	17.9%	-8.1%	54.3%	30.7%	143.0%	$10,000	0.000	594
	(0.192)	(0.573)	(0.008)	(0.001)	(0.000)			
11.2 without control variables	10.7%	-14.8%	28.3%	8.3%	129.3%			
	(0.361)	(0.335)	(0.102)	(0.290)	(0.000)			
Medicare Part A Expenditures for 18 Months After Hospital Admission (censored regression)* **								
12.1 with control variables**	15.8%	-1.2%	16.1%	68.0%	10.3%	$103,000	0.000	612
	(0.111)	(0.920)	(0.211)	(0.000)	(0.145)			
12.2 without control variables	19.5%	-3.5%	11.9%	61.0%	8.1%			
	(0.036)	(0.745)	(0.334)	(0.000)	(0.212)			
Medicare Part B Expenditures for 18 Months After Hospital Admission (censored regression)								
13.1 with control variables**	54.3%	13.2%	70.1%	49.5%	185.2%	$9,000	0.000	594
	(0.002)	(0.434)	(0.003)	(0.000)	(0.000)			
13.2 without control variables	45.4%	10.1%	47.1%	27.5%	167.2%			
	(0.002)	(0.571)	(0.010)	(0.006)	(0.000)			
Total Part A Expenditures for 18 Months After Hospital Admission (censored regression)* **								
14.1 with control variables**	20.6%	-7.2%	28.3%	74.0%	15.6%	$113,000	0.001	612
	(0.050)	(0.544)	(0.044)	(0.000)	(0.041)			
14.2 without control variables	21.5%	-10.0%	20.1%	66.7%	10.7%			
	(0.024)	(0.372)	(0.119)	(0.000)	(0.116)			
Total Part B Expenditures for 18 Months After Hospital Admission (censored regression)								
15.1 with control variables**	54.8%	14.9%	69.4%	49.5%	186.1%	$11,000	0.000	594
	(0.001)	(0.381)	(0.003)	(0.000)	(0.000)			
15.2 without control variables	45.9%	12.0%	46.8%	27.3%	168.9%			
	(0.002)	(0.505)	(0.010)	(0.006)	(0.000)			
Medicare Part A Expenditures per Day Alive for 18 Months After Hospital Admission (censored regression)* **								
16.1 with control variables**	-34.0%	-61.9%	-39.3%	-14.1%	-49.1%	$1,302	0.185	612
	(0.002)	(0.000)	(0.003)	(0.085)	(0.000)			
16.2 without control variables	-32.8%	-59.2%	-44.5%	-5.1%	-49.0%			
	(0.000)	(0.000)	(0.000)	(0.525)	(0.000)			
Medicare Part B Expenditures per Day Alive for 18 Months After Hospital Admission (censored regression)								
17.1 with control variables**	-31.3%	-70.9%	-13.0%	-15.5%	13.4%	$111	0.192	594
	(0.030)	(0.000)	(0.577)	(0.232)	(0.426)			
17.2 without control variables	-30.0%	-64.4%	-19.4%	-14.1%	7.3%			
	(0.018)	(0.000)	(0.252)	(0.168)	(0.599)			
Total Part A Expenditures per Day Alive for 18 Months After Hospital Admission (censored regression)* **								
18.1 with control variables**	-36.1%	-63.7%	-34.0%	-7.2%	-49.7%	$1,382	0.223	612
	(0.001)	(0.000)	(0.020)	(0.430)	(0.000)			
18.2 without control variables	-30.8%	-62.4%	-40.3%	3.9%	-50.8%			
	(0.002)	(0.000)	(0.002)	(0.666)	(0.000)			
Total Part B Expenditures per Day Alive for 18 Months After Hospital Admission (censored regression)								
19.1 with control variables**	-31.1%	-70.4%	-13.2%	-15.5%	13.4%	$139	0.187	594
	(0.030)	(0.000)	(0.568)	(0.230)	(0.426)			
19.2 without control variables	-29.8%	-63.8%	-19.6%	-14.2%	7.1%			
	(0.018)	(0.000)	(0.245)	(0.163)	(0.601)			

Numbers in parentheses are p-values for the hypothesis of "no difference."

*Statistic reported is p-value for likelihood-ratio (LR) test of hypothesis that all coefficients of control variables are zero.

**Control variables are risk groups based on claims data, age, sex, type of Part A claim in previous 12 months, ventilator dependence before hospital admission, functional dependence at admission, and eligibility group.

***Estimates for Part A differences are for beneficiaries who have not exhausted their Part A benefits.

For Sinai cases, adjusted Part A Medicare and total expenditures are, respectively, 37 and 47 percent higher than for UCDSS cases during the hospital stay, but only 16 and 18 percent higher for the 18-month period. The lower values for the 18-month period reflect the relatively high rate of mortality at discharge for Sinai. Differences for Part B expenditures are similar. Despite these higher total expenditures, both Part A and Part B expenditures per day alive were lower than for UCDSS cases, although differences were generally not statistically significant. The lower expenditures per day alive reflect somewhat longer survival times for Sinai patients. The longer survival times for Sinai cases are entirely accounted for by longer hospital stays.

For RMS cases, Part A expenditures are from 68 to 74 percent higher than for UCDSS cases after adjustment, depending on the measure. Part B expenditures during the hospital stay are less than 10 percent higher, but for the 18 month period they are 18 percent higher. Expenditures per day alive are 7 to 15 percent lower, depending on the measure, but the difference is not statistically significant. As with Sinai patients, the longer survival times are entirely accounted for by longer hospital stays.

C. Differences among Demonstration Units

In this section we report the clinical findings obtained using data for VDU cases only. The models reported parallel those reported in Section III.C, but use risk variables based on the VDU clinical data.

In estimating most of these models, we used the Mayo pre-demonstration cases as the base group; that group can be viewed as a comparison group for the demonstration groups. Three models necessarily exclude Mayo pre-demonstration cases (for VDU LOS, and total and Medicare Part A expenditures during the VDU stay); the base group in these models is Temple. Estimated differences between any pair of groups are invariant to the choice of the base group. Findings from the VDU-only models are summarized in Exhibits 5.16 (clinical outcomes) and 5.17 (expenditures).

Upon examination of the findings in these exhibits, we found it more useful to compare findings among the four VDU groups only (i.e., the Mayo demonstration cases and the cases from the other three units). Hence, we converted the differences to differences between the first three units and Temple for all measures. We also converted the findings from the models estimated with the combined VDU and UCDSS data in an analogous fashion. The differences from the two sets of models are compared in Exhibits 4.18 (clinical outcomes) and 5.19 (expenditures).

The discussion in the remainder of this section is based on the estimates reported in Exhibits 5.18 and 5.19, unless otherwise indicated.

Exhibit 5.16

Summary of Results for Clinical Models Using VDU Cases Only

Dependent Variable, Model Type, and Model Number	Difference between VDU Outcome and Mayo Pre-Demonstration Outcome				Mayo Pre. Demo. Value	LR Test* p-value	n
	Mayo	Mt. Sinai	RMS	Temple			
Length of Hospital Stay (duration)	percent difference						
1.1V with control variables**	-11.8%	100.4%	30.3%	30.5%	77.8	0.092	211
	(0.337)	(0.000)	(0.040)	(0.029)			
1.2V without control variables	-14.4%	69.4%	27.6%	23.9%			
	(0.254)	(0.001)	(0.048)	(0.095)			
Weaned at Discharge (logit)	percentage point difference						
2.1V with control variables**	-2.0	-62.8	-30.4	-16.3	72.7%	0.171	177
	(0.918)	(0.016)	(0.149)	(0.411)			
2.2V without control variables	-10.2	-52.7	-35.9	-19.8			
	(0.556)	(0.011)	(0.034)	(0.239)			
Alive at Discharge (logit)	percentage point difference						
3.1V with control variables**	0.5	-44.2	-35.3	-12.5	80.0%	0.363	211
	(0.975)	(0.062)	(0.067)	(0.481)			
3.2V without control variables	0.0	-32.8	-24.7	-9.6			
	(1.000)	(0.083)	(0.121)	(0.530)			
Self or Family Caregiver at Discharge (logit)	percentage point difference						
4.1V with control variables**	*(too few patients in self/family category to estimate)*				14.2%	n.a.	107
4.2V without control variables	20.0	21.4	9.6	16.2			
	(0.184)	(0.186)	(0.628)	(0.334)			
Rugs III Index (regression)	difference in RUGSIII points						
5.1V with control variables**	-1.8	4.4	2.0	2.1	9.0	0.014	112
	(0.283)	(0.060)	(0.247)	(0.183)			
5.2V without control variables	-1.2	4.9	2.8	2.0			
	(0.548)	(0.054)	(0.104)	(0.248)			
Discharged to Home (logit)	percentage point difference						
6.1V with control variables**	-28.3	-32.5	-60.9	-39.1	66.7%	0.087	128
	(0.248)	(0.277)	(0.001)	(0.070)			
6.2V without control variables	-9.0	-11.1	-52.1	-16.7			
	(0.600)	(0.605)	(0.001)	(0.315)			
Survival Post Discharge (duration)	percent difference						
7.1V Survival Post Discharge (duration)	-32.0%	-64.8%	-58.3%	-40.0%	1,031	0.029	140
	(0.337)	(0.046)	(0.022)	(0.177)			
7.2V Survival Post Discharge (duration)	-32.5%	-75.7%	-71.4%	-41.3%			
	(0.336)	(0.005)	(0.001)	(0.151)			
VDU Length of Stay (duration)							
20.1V with control variables**	-22.9%	41.1%	37.2%	(Temple	41.2	0.039	196
	(0.077)	(0.078)	(0.012)	is base)	(Temple)		
20.2V without control variables	-22.8%	48.0%	42.6%				
	(0.060)	(0.025)	(0.002)				

Numbers in parentheses are p-values for the hypothesis of "no difference."
*Statistic reported is p-value for likelihood-ratio (LR) test of hypothesis that all coefficients of control variables are zero.
**Control variables are risk groups based on VDU clinical data, age, sex, type of Part A claim in previous 12 months, ventilator dependence before hospital admission, functional dependence at admission, and eligibility group. Equation for VDU length of stay also includes hospital lenght of stay before VDU admission.

Exhibit 5.17

Summary of Results for Expenditure Models Using VDU Cases Only

Dependent Variable, Model Type, and Model Number	Difference between VDU Outcome and Mayo Pre-Demonstration Outcome				Mayo Pre. Demo. Value	LR Test* p-value	n
	Mayo	Mt. Sinai	RMS	Temple			
Medicare Part A Expenditures During Hospital Stay (censored regression)* **							
8.1V with control variables**	12.9%	33.6%	51.7%	0.4%	$88,000	0.153	211
	(0.307)	(0.065)	(0.000)	(0.976)			
8.2V without control variables	11.2%	20.3%	46.7%	1.9%			
	(0.354)	(0.170)	(0.000)	(0.855)			
Medicare Part B Expenditures During Hospital Stay (censored regression)							
9.1V with control variables**	48.4%	125.5%	54.7%	207.1%	$6,000	0.109	193
	(0.047)	(0.003)	(0.014)	(0.000)			
9.2V without control variables	25.6%	39.9%	23.4%	146.2%			
	(0.160)	(0.068)	(0.153)	(0.000)			
Total Part A Expenditures During Hospital Stay (censored regression)* **							
10.1V with control variables**	32.8%	84.2%	80.6%	22.9%	$90,000	0.018	211
	(0.030)	(0.001)	(0.000)	(0.128)			
10.2V without control variables	19.5%	36.5%	62.3%	9.4%			
	(0.122)	(0.021)	(0.000)	(0.396)			
Total Part B Expenditures During Hospital Stay (censored regression)							
11.1V with control variables**	47.3%	123.0%	52.8%	205.3%	$8,000	0.100	193
	(0.051)	(0.004)	(0.017)	(0.000)			
11.2V without control variables	24.1%	37.6%	21.5%	143.3%			
	(0.181)	(0.082)	(0.183)	(0.000)			
Medicare Part A Expenditures for 18 Months After Hospital Admission (censored regression)* **							
12.1V with control variables**	33.5%	29.0%	81.7%	15.4%	$96,000	0.739	211
	(0.026)	(0.134)	(0.000)	(0.245)			
12.2V without control variables	30.6%	24.6%	73.2%	18.6%			
	(0.033)	(0.129)	(0.000)	(0.137)			
Medicare Part B Expenditures for 18 Months After Hospital Admission (censored regression)							
13.1V with control variables**	30.2%	47.3%	30.0%	164.6%	$8,000	0.268	193
	(0.251)	(0.221)	(0.220)	(0.000)			
13.2V without control variables	26.5%	39.7%	15.4%	123.9%			
	(0.139)	(0.054)	(0.330)	(0.000)			
Total Part A Expenditures for 18 Months After Hospital Admission (censored regression)* **							
14.1V with control variables**	51.0%	67.4%	100.4%	37.6%	$101,000	0.491	211
	(0.001)	(0.001)	(0.000)	(0.006)			
14.2V without control variables	44.1%	44.3%	92.5%	30.7%			
	(0.006)	(0.015)	(0.000)	(0.027)			
Total Part B Expenditures for 18 Months After Hospital Admission (censored regression)							
15.1V with control variables**	28.4%	44.1%	27.5%	160.6%	$11,000	0.249	193
	(0.279)	(0.251)	(0.259)	(0.000)			
15.2V without control variables	24.9%	37.4%	13.5%	121.4%			
	(0.160)	(0.067)	(0.389)	(0.000)			
Medicare Part A Expenditures per Day Alive for 18 Months After Hospital Admission (censored regression)* **							
16.1V with control variables**	141.1%	242.9%	437.1%	89.5%	$318	0.000	211
	(0.000)	(0.000)	(0.000)	(0.002)			
16.2V without control variables	124.8%	195.9%	465.2%	86.8%			
	(0.000)	(0.000)	(0.000)	(0.003)			
Medicare Part B Expenditures per Day Alive for 18 Months After Hospital Admission (censored regression)							
17.1V with control variables**	84.4%	108.8%	137.0%	212.4%	$28	0.117	193
	(0.062)	(0.071)	(0.003)	(0.000)			
17.2V without control variables	111.3%	135.1%	150.4%	219.0%			
	(0.010)	(0.006)	(0.000)	(0.000)			
Total Part A Expenditures per Day Alive for 18 Months After Hospital Admission (censored regression)* **							
18.1V with control variables**	172.1%	214.6%	394.3%	87.7%	$330	0.010	211
	(0.000)	(0.000)	(0.000)	(0.002)			
18.2V without control variables	143.8%	173.7%	389.9%	81.5%			
	(0.000)	(0.001)	(0.000)	(0.009)			
Total Part B Expenditures per Day Alive for 18 Months After Hospital Admission (censored regression)							
19.1V with control variables**	81.7%	103.8%	132.3%	205.9%	$35	0.115	193
	(0.069)	(0.082)	(0.004)	(0.000)			
19.2V without control variables	106.9%	129.6%	145.2%	212.1%			
	(0.013)	(0.007)	(0.001)	(0.000)			
Medicare Part A Expenditures during VDU Stay (censored regression)* **							
21.1V with control variables**	24.9%	49.6%	80.9%			0.050	192
	(0.088)	(0.024)	(0.000)	(Temple	(Temple)		
21.2V without control variables	19.4%	56.4%	84.6%	is base)			
	(0.132)	(0.005)	(0.000)				
Total Part A Expenditures during VDU Stay (censored regression)* **							
22.1V with control variables**	12.3%	68.4%	89.1%	(Temple		0.038	192
	(0.429)	(0.010)	(0.000)	is base)	(Temple)		
22.2V without control variables	8.8%	69.7%	96.8%				
	(0.536)	(0.003)	(0.000)				

Numbers in parentheses are p-values for the hypothesis of "no difference."

*Statistic reported is p-value for likelihood-ratio (LR) test of hypothesis that all coefficients of control variables are zero.

**Control variables are risk groups based on VDU clinical data, age, sex, type of Part A claim in previous 12 months, ventilator dependence before hospital admission, functional dependence at admission, and eligibility group.

***Estimates for Part A differences are for beneficiaries who have not exhausted their Part A benefits.

Exhibit 5.18

Comparison of Differences in Clinical Outcomes Among VDUs for VDU and UCDSS Models vs. VDU only Models

Dependent Variable, Model Type, and Model Number	Difference between VDU Outcome and Mayo Pre-Demonstration Outcome			Temple Outcome
	Mayo	Mt. Sinai	RMS	
Length of Hospital Stay (duration)	difference in adjusted mean days			
1.1 VDU and UCDSS Model**	-52	65	12	101.55
1.1V VDU only Model	-43	71	0	
Weaned at Discharge (logit)	difference in adjusted percent			
2.1 VDU and UCDSS Model**	11.1	-32.1	-13.5	44.3%
2.1V VDU only Model	14.3	-46.5	-14.1	
Alive at Discharge (logit)	difference in adjusted percent			
3.1 VDU and UCDSS Model**	6.1	-20.1	-18.8	64.5%
3.1V VDU only Model	13.0	-31.7	-22.9	
Self or Family Caregiver at Discharge (logit)	difference in adjusted percent			
4.1 VDU and UCDSS Model**	25.0	31.9	-2.7	8.1%
4.1V VDU only Model	*(too few patients in self/family category to estimate)*			
Rugs III Index (regression)	difference in RUGSIII points			
5.1 VDU and UCDSS Model**	-5.0	-0.2	1.8	12.4
5.1V VDU only Model	-4.0	2.3	-0.1	
Discharged to Home (logit)	difference in adjusted percent			
6.1 VDU and UCDSS Model**	15.4	6.5	-35.9	36.6%
6.1V VDU only Model	10.8	6.6	-21.8	
Survival Post Discharge (duration)	difference in adjusted mean			
7.1V VDU and UCDSS Model**	-2	-406	-402	617
7.2V VDU only Model	49	-153	-113	

Exhibit 5.19

Comparison of Differences in Expenditures Among VDUs
for VDU and UCDSS Models vs. VDU only Models

Dependent Variable, Model Type, and Model Number	Difference between VDU Outcome and Temple Outcome (adjusted)			Temple Outcome
	Mayo	Mt. Sinai	RMS	
Medicare Part A Expenditures During Hospital Stay (censored regression)* **				
8.1 VDU and UCDSS Model**	$6,050	$24,824	$54,957	$88,353
8.1V VDU only Model	$11,010	$29,370	$45,360	
Medicare Part B Expenditures During Hospital Stay (censored regression)				
9.1 VDU and UCDSS Model**	-$23,047	-$16,096	-$20,622	$18,426
9.1V VDU only Model	-$29,235	-$15,042	-$28,090	
Total Part A Expenditures During Hospital Stay (censored regression)* **				
10.1 VDU and UCDSS Model**	$8,300	$38,454	$69,266	$110,588
10.1V VDU only Model	$11,023	$67,848	$63,814	
Total Part B Expenditures During Hospital Stay (censored regression)				
11.1 VDU and UCDSS Model**	-$30,547	-$21,658	-$27,423	$24,421
11.1V VDU only Model	-$38,587	-$20,089	-$37,231	
Medicare Part A Expenditures for 18 Months After Hospital Admission (censored regression)* **				
12.1 VDU and UCDSS Model**	$6,135	$6,392	$63,950	$110,758
12.1V VDU only Model	$20,087	$15,144	$73,425	
Medicare Part B Expenditures for 18 Months After Hospital Admission (censored regression)				
13.1 VDU and UCDSS Model**	-$27,697	-$24,370	-$28,726	$21,167
13.1V VDU only Model	-$28,443	-$24,835	-$28,498	
Total Part A Expenditures for 18 Months After Hospital Admission (censored regression)* **				
14.1 VDU and UCDSS Model**	$6,890	$17,605	$81,170	$138,951
14.1V VDU only Model	$18,631	$41,392	$87,255	
Total Part B Expenditures for 18 Months After Hospital Admission (censored regression)				
15.1 VDU and UCDSS Model**	-$37,630	-$33,450	-$39,156	$28,671
15.1V VDU only Model	-$37,916	-$33,430	-$38,173	
Medicare Part A Expenditures per Day Alive for 18 Months After Hospital Admission (censored regression)* **				
16.1 VDU and UCDSS Model**	$91	$59	$211	$603
16.1V VDU only Model	$311	$924	$2,095	
Medicare Part B Expenditures per Day Alive for 18 Months After Hospital Admission (censored regression)				
17.1 VDU and UCDSS Model**	-$39	-$23	-$25	$87
17.1V VDU only Model	-$112	-$91	-$66	
Total Part A Expenditures per Day Alive for 18 Months After Hospital Admission (censored regression)* **				
18.1 VDU and UCDSS Model**	$84	$97	$263	$619
18.1 VDU only Model	$523	$786	$1,899	
Total Part B Expenditures per Day Alive for 18 Months After Hospital Admission (censored regression)				
19.1 VDU and UCDSS Model**	-$48	-$29	-$31	$107
19.1V VDU only Model	-$133	-$109	-$79	

1. Clinical Outcomes

While there are differences, for the most part findings from the models using the combined VDU and UCDSS data are in close agreement with those using the VDU data alone, despite the change in risk measurement. Using either set of adjusted estimates, Mayo cases have substantially shorter lengths of stay, are somewhat more likely to be weaned, are somewhat more likely to be alive at discharge, have lower RUGS-III scores among those discharged alive, and are more likely to be discharged home than Temple cases. Mt. Sinai cases have much longer stays, are much less likely to be weaned at discharge, and are much less likely to be discharged alive than Temple patients, and for those discharged alive the adjusted difference in mean RUGS-III score is small, and Sinai cases are somewhat more likely to be discharged home. RMS cases were less likely to be weaned and less likely to be alive at discharge than Temple patients, and for those discharged alive the adjusted difference in mean RUGS-III score is small, and RMS patients were much less likely to be discharged home.

There are two ways in which the clinical findings from the two sets of estimates differ. First, when both data sets are used the adjusted difference between the mean length-of-stay for RMS cases and Temple cases is 12 days, which is a substantial difference, whereas the difference is essentially zero based on the model estimated with VDU data only.

Second, the post-discharge survival results using the combined data show that mean survival time for both Sinai and RMS cases is just over 400 days less than for Temple cases, but results from the VDU-only models show adjusted differences of 153 and 113 days less for Sinai and RMS cases, respectively. The VDU-only results also show that adjusted mean survival time for Mayo cases is 49 days greater than for Temple cases, whereas the combined results show a difference of just two days. We have not been able to determine why post-discharge survival findings from the two models differ so greatly. As noted in Section II of this chapter, the duration models for survival proved to be the most problematic to estimate, and the difference in findings may be related to the estimation problems.

2. Expenditure Outcomes

Many of the expenditure findings from the two sets of models are very similar, but we also found more dissimilar findings than in the clinical models. As discussed at the beginning of this section, the risk and eligibility variables had more explanatory power in the expenditure equations than in the clinical equations, and this may explain the higher prevalence of dissimilar findings.

Results for each of the following five expenditure variables from both sets of estimates are similar: Medicare Part A expenditures during the hospital stay, Medicare and total Part B expenditure during the hospital stay, and Medicare and total Part B expenditure during the 18 months after hospital admission. Findings for total Part A expenditures during the hospital stay from the two sets of estimates are very similar for Mayo and RMS cases, but quite different for

Sinai cases. The overall picture based on the findings that are similar for both sets of estimates is that expenditures for Mayo cases for Part A and Part B combined, after adjustment, were about $10,000 to $20,000 per case lower than for Temple cases, while those for Sinai cases were about $10,000 to $40,000 per case higher and those for RMS cases were from $17,000 to $42,000 higher.

Results for Part A Medicare and total expenditures in the 18-month period and for all expenditures per day alive are quite different across the two sets of estimates. In comparison to Temple's estimates, Part A expenditures and Part A expenditures per day alive for the other units are substantially higher when estimated from the VDU-only model than when estimated from the combined model, but the VDU-only estimates of Part B expenditures per day alive for these units are lower relative to Temple's than are the estimates from the combined data. In general, it appears Temple outcomes for both the clinical and expenditure measures improve relative to those for the other units when the VDU-only data and risk variables are used. It also seems likely that the differences in the findings for the expenditure per day alive variables is related to the differences in the findings for the post-discharge survival variables.

While the risk variables that we use in the VDU-only model are conceptually preferred to those used in the combined models, we think it is premature to concluded that estimates from the VDU-only specifications should be preferred -- especially for the post-discharge survival and expenditure per day models. The differences found in the latter models appear to be too large to be credible. The sample sizes are much smaller in the VDU-only models, and it may well be that a few outliers are skewing some of the results.

CHAPTER SIX

NATIONAL IMPLEMENTATION ANALYSIS

I. INTRODUCTION

The objectives of the national implementation analysis are to estimate:

1. The number of "at-risk" Medicare cases, defined as those hospital stays for which the beneficiary would have satisfied the clinical criteria for VDU admission as they were applied in the Demonstration; and
2. The additional Medicare expenditures and total expenditures necessary to pay for VDU treatment for all at-risk beneficiaries.

We provide a range of estimates for both at-risk cases and expenditures. As will be seen, the ranges of the estimates are very wide. Future revisions of our estimate of the percent of UCDSS cases that are at-risk may narrow the ranges somewhat, but wide ranges will remain. These ranges reflect both uncertainty about the share of UCDSS cases that might be admitted to a VDU-type unit under national implementation, and the wide range of VDU experiences during the demonstration.

We use the findings for the RMS VDU to estimate expenditures under a "high expenditure" scenario, and use the findings from the Temple VDU to estimate expenditures under a "low expenditure" scenario. Estimates based on the Mayo findings would be similar to those based on the Temple findings, while estimates based on the Sinai findings would be similar to those based on the RMS findings.

II. METHODOLOGY

To estimate the number of at-risk Medicare hospital stays, we used results of the admissions analysis along with published tabulations on discharges for FY 1994, from HCFA's MEDPAR file. Results from the outcome analysis of expenditures (see Section IV.C.5) were then used to compute the average additional Medicare and total expenditures for the average at-risk patient.

A. Estimation of "At-risk" Cases

Based on the findings from the clinical review of eligibility, we estimate that from 67 to 80 percent of UCDSS cases would have been admitted to a VDU had there been a national program in place. This range is consistent with the 72 percent point estimate obtained from the findings from our classification of cases into eligibility groups. Hence, we use 67 and 80 percent as the lower and upper bound estimates, respectively, of the share of UCDSS cases that would be admitted to a VDU under national implementation.

Recall that the UCDSS sample consists almost entirely of discharges under DRG 483 with a hospital length-of-stay of at least 20 days that were observed over the collection period in the five states used for testing the UCDSS.[1] Although these cases are not nationally representative of all such cases, there is no obvious reason to believe that the share of all such cases at-risk for being VDU eligible falls outside the range of shares estimated from our sample. Hence, we first estimated the number of discharges under DRG 483 with a hospital length-of-stay of at least 20 days, then applied the upper and lower bound estimates of the share eligible to obtain an estimate of the number of at-risk cases under DRG 483.

As discussed in the introduction, many ventilator episodes are paid under DRGs 475 and 482, although more than 75 percent of stays under these DRGs were shorter than 20 days in 1994. We applied the same methodology to estimating the number of at-risk cases under DRG 482 as under DRG 483. We also used the same method for DRG 475 to obtain the upper bound of the number at-risk, but use a lower figure for the lower bound estimate. The lower figure is based on a finding from the early sampling of UCDSS cases. For the 51 cases we found under DRG 483 in a small random sample of hospital claims, we only found four under DRG 475, or 7.8 percent as many. If we apply the same methodology to estimate at-risk cases under DRG 475 as used for DRG 482, the number found for DRG 475 is 56.1 percent of the number for DRG 482. Based on our sampling experience, we suspect that this figure is much too large. It may be that many DRG 475 cases with long hospital stays do not have long ventilator episodes because they did not have a tracheostomy; hence they are less likely to be at-risk for VDU admission than are patients in DRGs 482 and 483 with stays of the same length. Hence, we use 7.8 percent of our estimate of at-risk cases under DRG 483 as our lower bound estimate of at-risk cases under DRG 475. This is equivalent to assuming that just 9.9 percent of the DRG 475 cases with LOS of at least 20 days would be admitted to a VDU.

Data on the FY1994 number of cases, distributions of LOS, and standard payments for DRGs 475, 482, and 483 appear in Exhibit 1.1 (see Chapter 1). We used the five reported percentiles for each DRG to fit a log-normal distribution for length of stay.[2] MEDPAR based estimates of the number of cases with LOS of at least 20 days appear in Exhibit 6.1, along

[1] Recall also that the analysis sample excluded some cases from the full UCDSS sample because they were readmissions or because they had short ventilator episodes. Technically, we should make adjustments for this in the current analysis, but the net size of the offsetting adjustments would be very small -- on the order of one or two percentage points.

[2] The log-normal distribution fits the reported percentiles very well. For DRGs 475 and 482 we fit the distribution to the 75th and 90th percentiles only because this is the relevant range of the distribution. For DRG 483 we fit the distribution to the 25th, 50th, 75th, and 90th percentiles. The fitted distributions replicated each percentile fit with an error of less than one day. The fitted means and standard deviations for the log of LOS are:

DRG:	475	482	483
mean of *ln*(LOS)	2.303	2.485	3.664
SD of ln(LOS)	0.787	0.681	0.659

Exhibit 6.1

Inputs to the National Implementation Analysis (FY 1994)

(expenditures in billions)

Estimated Cases with LOS > 19		
DRG 475	17,677	
DRG 482	1,726	
DRG 483	31,509	
Total	50,912	
Estimated Medicare Part A Expenditures for Cases with LOS > 19**		
DRG 475	$0.32	
DRG 482	$0.03	
DRG 483	$1.66	
Total	$2.01	
Estimated Total Part A Expenditures for Cases with LOS > 19**		
DRG 475	$0.40	
DRG 482	$0.04	
DRG 483	$2.07	
Total	$2.51	
Expenditure Ratios from UCDSS Cases		
Med. Part B/Med. Part A (hosp. stay)	0.10	
Total Part B/Total Part A (hosp. stay)	0.11	
18 mos. Med. Part A/hosp. Med. Part A	1.25	
18 mos. Total Part A/hosp. Total Part A	1.27	
18 mos. Med. Part B/hosp. Med. Part B	1.10	
18 mos. Total Part B/hosp. Total Part B	1.10	
Estimates from Admissions and Outcome Analyses		
	Lower Bound*	**Upper Bound***
% VDU Eligible	67.0%	80.0%
Findings for Temple and RMS		
	Temple	**RMS**
% Exhausting Part A Inpatient Benefit x 100	5.3%	14.0%
% Increase in Med. Part A Exp. (hosp. stay)	8.5%	70.7%
% Increase in Total Part A Exp. (hosp. stay)	12.5%	75.1%
% Increase in Med. Part B Exp. (hosp. stay)	142.8%	30.9%
% Increase in Total Part B Exp. (hosp. stay)	143.0%	30.7%
% Increase in Med. Part A Exp. for 18 mos.	10.3%	68.0%
% Increase in Total Part A Exp. for 18 mos.	15.6%	74.0%
% Increase in Med. Part B Exp. for 18 mos.	185.2%	49.5%
% Increase in Total Part B Exp. for 18 mos.	186.1%	49.5%

*Bounds for percent VDU eligible are based on the admission analysis findings (Chapter 4). The lower bound is applied to DRGs 482 and 483 cases only. The lower bound for DRG 475 cases is9.87 percent. For other variables, the lower bound refers to the "low expenditure" scenario, under which expenditures for at-risk cases are assumed to reflect those for Temple cases, and the upper bound refers to the "high expenditure" scenario, under which expenditures for at-risk cases are assumed to reflect those for RMS cases. The values for the shares exhausting Part A inpatient benefits are the estimated shares for Temple and RMS (Exhibit 5.9). Percent increases in other variables are estimated percent differences between Temple and UCDSS cases (low scenario) and RMS and UCDSS cases (high scenario) after adjusting for the control variables (Exhibit 5.15).

with the shares assumed to be VDU eligible and other inputs into the national implementation analysis (see Section II.B).

B. Estimation of Additional Medicare Expenditures

This analysis uses findings from the admission and impact analyses on expenditures along with baseline estimates of total and Medicare Part A expenditures for "at-risk" cases in FY1994 estimates. The baseline estimates were obtained by using the fitted log-normal distributions for DRG 475, 482, and 483 to estimate the number of discharges with length of stay equal to 20 days, 21 days, 22 days, etc. up through 150 days or longer. We then used the national standard DRG payment, the outlier payment rate, and the Part A coinsurance rate schedule to calculate the standard payment for each number of days. We assumed that patients did not exhaust their lifetime benefits until day 150, and that payments for all stays longer than 150 days are the same as for stays of exactly 150 days. We multiplied Medicare and total estimated expenditures by the upper and lower bound estimates of the share of cases that were VDU eligible to get upper and lower bounds for baseline Medicare and total expenditures. As with at-risk cases, we assumed that only 9.8 percent of expenditures for DRG 475 were for at-risk cases for the lower bound, rather than the 71.0 percent assumed for DRGs 482 and 483.

To estimate baseline Part A expenditures for the 18 months after admission, we multiplied the Part A expenditures for the hospital stay under each scenario by the ratio of mean Part A expenditures for the 18 months after admission for UCDSS cases divided by the UCDSS mean for Part A expenditures for the hospital stay. Analogous ratios were applied to obtain baseline estimates for Part B expenditures during the hospital stay and for the 18 months following hospital admission.

We estimated the increase in national expenditures from national implementation under two scenarios. For each scenario we provide estimates with both the upper and lower bound caseload estimates. Under the "high expenditure" scenario, we assume that increases in expenditures will reflect the adjusted percent difference between mean expenditures in each category for RMS cases and those in the corresponding category for UCDSS cases. The estimated Part A increases are then reduced by the share of RMS cases that exhausted Part A benefits during the hospital stay. Under the "low expenditure" scenario, we make analogous assumptions using the findings for Temple. Findings from the outcome analysis that were used in the national implementation analysis are shown in Exhibit 6.1.

III. FINDINGS

A. Baseline Estimates

We estimate that there were between 24 and 41 thousand at-risk Medicare cases in 1994 (Exhibit 6.2). If the number at-risk were at the low end of this range, Medicare expenditures for these cases was about $1.3 billion during the hospital stay and about $1.6

Exhibit 6.2

Results for National Implementation Analysis (1994)

(expenditures are in billions)

Item	At-risk Case Assumption**	
	Lower Bound	Upper Bound
Baseline Estimates for At-risk Cases		
Number of Cases	24,012	40,729
Med. Part A During Hospital Stay	$1.16	$1.60
Total Part A During Hospital Stay	$1.45	$2.01
Med. Part B During Hospital Stay	$0.12	$0.16
Total Part B During Hospital Stay	$0.16	$0.22
Medicare Total During Hospital Stay	**$1.28**	**$1.76**
Total During Hospital Stay	**$1.61**	**$2.23**
Med. Part A for 18 mos.	$1.45	$2.01
Total Part A for 18 mos.	$1.84	$2.55
Med. Part B for 18 mos.	$0.13	$0.18
Total Part B for 18 mos.	$0.18	$0.24
Total Medicare for 18 mos.	**$1.58**	**$2.18**
Total for 18 mos.	**$2.02**	**$2.79**
Expenditure Increases under the *Low Expenditure* Scenario*		
Med. Part A During Hospital Stay	$0.09	$0.13
Total Part A During Hospital Stay	$0.17	$0.24
Med. Part B During Hospital Stay	$0.17	$0.23
Total Part B During Hospital Stay	$0.23	$0.32
Medicare Total During Hospital Stay	**$0.26**	**$0.36**
Total During Hospital Stay	**$0.40**	**$0.55**
Med. Part A for 18 mos.	$0.14	$0.20
Total Part A for 18 mos.	$0.27	$0.38
Med. Part B for 18 mos.	$0.24	$0.33
Total Part B for 18 mos.	$0.33	$0.45
Total Medicare for 18 mos.	**$0.38**	**$0.52**
Total for 18 mos.	**$0.60**	**$0.83**
Expenditure Increases under the *High Expenditure* Scenario*		
Med. Part A During Hospital Stay	$0.66	$0.92
Total Part A During Hospital Stay	$0.88	$1.22
Med. Part B During Hospital Stay	$0.04	$0.05
Total Part B During Hospital Stay	$0.05	$0.07
Medicare Total During Hospital Stay	**$0.70**	**$0.96**
Total During Hospital Stay	**$0.93**	**$1.28**
Med. Part A for 18 mos.	$0.85	$1.17
Total Part A for 18 mos.	$1.17	$1.62
Med. Part B for 18 mos.	$0.06	$0.09
Total Part B for 18 mos.	$0.09	$0.12
Total Medicare for 18 mos.	**$0.91**	**$1.26**
Total for 18 mos.	**$1.26**	**$1.74**

*Under the "low expenditure" scenario, increased expenditures per case are based on differences between Temple and UCDSS cases after adjusting for control variables. Under the "high expenditure" scenario, they are based on adjusted differences between RMS and UCDSS cases.
**Refers to percent of ventilator DRG cases with hospital stays of at least 20 days assumed to be at-risk. See Exhibit 6.1.

billion during the 18-month period following hospital admission. Total spending at the low end of this range is estimated to be $1.6 billion during the hospital stay and $2.0 billion during the 18-month period. At the high end of the range, we estimate Medicare expenditures during the hospital stay at $1.8 billion, and during the 18-month period at $2.2 billion; the corresponding figures for total expenditure are $2.2 and $2.8 billion, respectively.

B. Effects of National Implementation

Increases in Medicare and total expenditures are lowest under the combination of the lower bound assumption for the number of at-risk cases and the low expenditure (Temple) scenario. Under this combination, Medicare expenditures during the hospital stay increase by $0.26 billion (20 percent of the baseline) and Medicare expenditures during the 18-month period increase by $0.38 billion (24 percent of the baseline). The corresponding figures for total expenditures are $0.40 billion (26 percent of the baseline) and $0.60 billion (30 percent of the baseline).

Increases in Medicare and total expenditures are highest under the combination of the upper bound assumption for the number of at-risk cases and the high expenditure (RMS) scenario. Under this combination, Medicare expenditures during the hospital stay increase by $0.96 billion (55 percent of the baseline) and Medicare expenditures during the 18-month period increase by $1.26 billion (58 percent of the baseline). The corresponding figures for total expenditures are $1.28 billion (58 percent of the baseline) and $1.74 billion (62 percent of the baseline).

IV. Discussion

We find that national implementation with effective controls on admission and following the Temple model would have increased Medicare expenditures in 1994 about $0.4 billion, while implementation with ineffective controls on admission and following the RMS model would have increased Medicare expenditures by about $1.25 billion. While the increased expenditures in the low expenditure scenario might be justified by the relatively favorable outcomes found for the Temple cases, the outcomes for RMS cases were not demonstrably better than those for UCDSS cases.

The actual increase in expenditures under either scenario may differ from our estimates for a variety of reasons. Perhaps the most important lesson from this analysis is that national implementation of TEFRA cost reimbursement for VDUs will be an expensive proposition, with perhaps little gain in clinical outcomes, unless measures are taken to insure that VDU care is only provided to patients for whom such care is clinically warranted, and by units that can provide high quality care.

CHAPTER SEVEN
PATTERNS OF POST-ACUTE CARE FOR VENTILATOR DEPENDENT PATIENTS

I. INTRODUCTION

In this chapter we discuss the methodology used to examine patterns of post-acute care for ventilator dependent patients, provide some background on the health care environment, and provide some descriptive statistics of patient characteristics for the study sample. We also discuss the findings from examining the patterns of post-acute care. We conclude this chapter by discussing the results.

II. METHODOLOGY

We used Part A claims data for all patients for whom we were able to capture claims data[1] (n=687). Part A claims were collected for a period of 18 months for each patient, starting with his or her admission to an acute setting just prior to the beginning of the ventilator episode.[2] This 18 month period made up the study period. Some study subjects may have claims beyond this 18 month period that would not be included in the study. Some of the patients in the study did not have complete data for the 18 month study period (see Exhibit 7.1). The anomalies range from 8 percent of patients in the Temple VDU to 32 percent of patients in the RMS VDU. Overall 16 percent of patients do not have complete study data.

We examined claims in seven settings. A setting is defined for the purposes of this study as either the type of health care facility where a patient received care or services that a patient received.[3] We examined claims for five inpatient settings (acute hospital, VDU, skilled nursing facility, rehabilitation hospital or unit, long-term care hospital), home health and hospice claims. We also observed gaps or interruptions in service for five or more days[4] that were both preceded and followed by a claim. We counted gaps in service as an eighth setting. We excluded Part B claims from the analysis.

---

[1] We used all Part A claims that we had obtained by 2/23/96. Any claims received after this date are not included in the analysis. The sample used for the post-acute analysis does not match the sample used for the outcome evaluation because of different data requirements. Also, non-invasive cases from the Temple VDU are included in the post-acute analysis, but not in the outcome analysis.

[2] Unless the 18 month period extended past 12/20/95, the last date for which data were available. In a few cases, the patient had been ventilator dependent in an alternative setting before hospital admission.

[3] Hospice care is a service that can be provided in different types of settings: the home, a SNF, a hospital, or a specialized hospice facility.

[4] The rationale for excluding gaps of less than five days was that such short gaps could occur because of date miscoding or delay in starting home health services.

Exhibit 7.1

Distribution of Study Patients by Completeness of Study Period Data and by Patient Population

	Ventilator Dependent Units								UCDSS Sample	
	Mayo		RMS		Sinai		Temple			
	No.	%	No.	%	No.	%	No.	%	No.	%
Patients with Full 18 Months of Study Data (a)	34	58%	7	7%	5	23%	37	53%	86	20%
Patients Who Died During Study Period (b)	19	32%	64	62%	11	50%	27	39%	282	66%
Patients Alive But Without 18 Months of Study Data (c)	6	10%	33	32%	6	28%	6	8%	61	14%
Totals	59	100%	104	100%	22	100%	70	100%	429	100%

(a) Patients had complete data for the 18 months following their admission to the hospital where they were ventilated.

(b) Patients died during the study period, according to Part A claims.

(c) Patients did not die in the study period, according to Part A claims, but we did not have claims for all 18 months following the patients' admission to the hospital.

We created a record for each person with a number of variables to allow us to examine the patterns of post-acute care. For any patient with Medicare Part A claims, we created the following variables:

- A variable to record the type of setting for each acute and post-acute service episode.[5] This variable was created from the provider number in the Part A Claims record that contains one or more digits to indicate the type of setting. The third through sixth digit of the provider number indicates that the setting is a VDU (T999).[6] The third digit of the provider number also indicates that a setting is a rehabilitation hospital (3) or unit (T), a long-term care hospital (2), a skilled nursing facility (SNF) (5), a home health agency (7), or a hospice (1). All other inpatient claims without these identifying codes were considered to be acute hospital service episodes.
- A variable indicating that the setting was a gap in service was created by comparing the beginning and ending dates for the claims. Any difference of five or more days was considered a gap in service. A period of time preceded by a claim but not followed by a claim within the study period is not considered to be a gap in service.

[5] For the purposes of this study, we defined a "service episode" as one or more days in a "setting."

[6] Mayo VDU admitted 18 patients prior to the demonstration start. VDU claims for these patients did not have the T999 designation and were not considered as VDU service episodes.

- A variable for the length of stay for each service episode in which the setting differed from the previous claim(s).
- A variable that recorded the pattern of settings for each patient that we called "path." For instance if the patient was in the acute hospital, then the VDU, went back to the hospital, and then went back to the VDU and had no further claims, their path variable would be 1212.
- A variable that counted the number of times a patient was in a particular setting following his or her first VDU service episode for a VDU patient or first hospital service episode for a patient from the UCDSS sample.
- A final discharge destination variable that is taken from the last claim for the patient. This variable was used to determine if the patient died in the last setting.[7]

We used the number of settings and days in each setting to compare post-acute patterns. Demographic variables (age, sex, and race) and ventilator status at discharge from the hospital (i.e., either the first VDU service episode for VDU patients or first hospital service episode for patients from the UCDSS sample) were taken from the data collected by VDU personnel or abstracted from the UCDSS data and were used to provide descriptive statistics. The results discussed in this Chapter are based exclusively on descriptive data.

In the next sections, we describe patterns of post-acute care for all patients and then focus on patterns by unit. (Data for all patients will be included on disk in the final report.)

III. Brief Descriptions of the Health Care Environment and Patient Characteristics

In this section we discuss briefly changes in the health care environment that have created pressures for hospitals to discharge patients to alternative care or post-acute care settings. We discuss the number of post-acute providers for the states in which the four VDUs are located, followed by some information on the characteristics of the patients studied.

A. The Health Care Environment

Medicare's payment systems for acute care have led to increased demand for post-acute care services for higher acuity patients. Medicare's Prospective Payment System (PPS) method incorporates strong incentives for hospitals to discharge Medicare patients as soon as appropriate.

Not surprisingly, the hospital average length of stay (ALOS) for Medicare enrollees fell substantially (by nearly eight percent) the year after PPS was introduced in 1983. Medicare patients are discharged "quicker and sicker" and the demand for post-acute care providers who can care for these higher acuity Medicare patients has increased. However, it was not until 1988/89 that Medicare-reimbursed services provided by post-acute care providers,

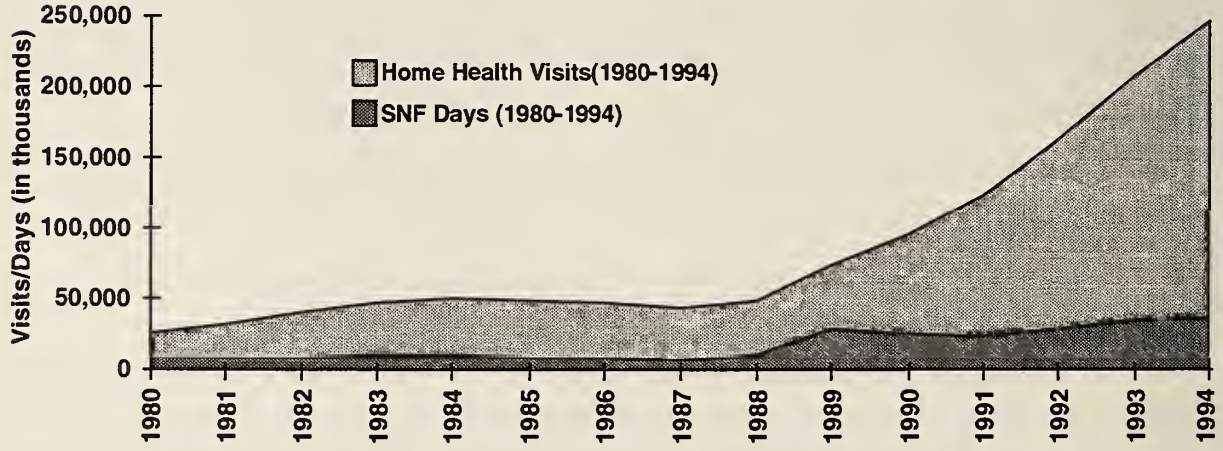
---

[7] We used the claims data to determine if a patient died in their last service episode. The outcomes analysis used a different source to determine patient death.

including rehabilitation and long-term hospitals, hospital-based and freestanding SNFs, and home health providers began to grow rapidly. Medicare beneficiaries' use of SNFs, for example, grew from less than 10 million days in 1980 to more than 30 million in 1994 (Exhibit 7.2). The use of home health services rose even faster, from approximately 25 million visits in 1980 to nearly 250 million visits in 1994. In part, the "delayed reaction" to PPS is a direct reflection of coverage criteria clarifications issued in 1988. In part, it is likely that the hospital length of stay reductions in the earliest years were accomplished to some degree by sending people home a little earlier without the need for substitute SNF or home care.

Exhibit 7.2

Medicare Home Health and SNF Use (1980-1994)



Source: Health Care Financing Administration, Bureau of Data Management and Strategy, and Office of the Actuary.

Medicare payment policies for post-acute care have encouraged the growth of subacute providers. The combination of strong incentives for discharge for acute care hospitals under PPS and for growth among post-acute care providers receiving cost-based reimbursement has led to both the strong demand for post-acute care services as well as an increasing number of post-acute care providers. Between 1986 and 1994, the total number of Medicare certified post-acute care providers grew by 34 percent and no type of provider grew by less than 24 percent in number (Exhibit 7.3). The largest percentage growth was among hospital-based SNFs, which grew in number from 652 in 1986 to 1,953 in 1994, an increase of 200 percent. This growth of hospital-based SNFs is probably in response to the strong incentives hospitals have to discharge patients and, as length of stay and utilization rates fall, convert empty acute beds to SNF beds and capture cost-based reimbursement for the patient's post-acute care requirements.

There are varying levels of post-acute providers in the four states where the four ventilator dependent units are located (see Exhibit 7.4). Although long-term care hospital beds per 1,000 state residents aged 65 or older are approximately the same across all four states, other types of providers vary widely. Rehabilitation hospital beds vary from 0.0 beds per 1,000 elderly state residents to 0.95 per 1,000. Of the four states, Michigan has the largest number of rehabilitation hospital beds. The biggest difference among the four states is the number of

Exhibit 7.3

Growth in Number of Medicare Certified Post-Acute Providers (1986-1994)

Type of Facility	1986	1990	1994	Total Growth 1986-94	Annual Growth 1990-1994
Rehabilitation					
Hospitals	75	135	187	149%	8.5%
Distinct-Part Units	470	687	804	71%	4.0%
Long-Term Care Hospitals(a)	94	90	120	28%	7.5%
Skilled Nursing Facilities					
Hospital-Based	652	1,145	1,953	200%	14.3%
Free-Standing	8,414	8,120	10,463	24%	6.5%
Home Health Agencies	5,907	5,949	7,363	25%	5.5%

Note: (a) These data are from HCFA's Office of Survey and Certification OSCAR file. Data from Medicare cost reports differ slightly.

Source: Prospective Payment Assessment Commission, Public Handout "Medicare Post-Acute Care: Overview and Spending," October 25, 1994.

Exhibit 7.4

Number of Post Acute Facilities and Beds in the Four States With Ventilator Dependent Units (VDUs)

Ventilator Dependent Unit (VDU)	Mayo		RMS		Sinai		Temple	
VDU Location	**MINNESOTA**		**ILLINOIS**		**MICHIGAN**		**PENNSYLVANIA**	
Type of Facility	Number of Facilities	Beds per 1000 population aged 65+ (4)	Number of Facilities	Beds per 1000 population aged 65+ (4)	Number of Facilities	Beds per 1000 population aged 65+ (4)	Number of Facilities	Beds per 1000 population aged 65+ (4)
Long-term care Hospitals (1)	1	0.27	3	0.26	6	0.35	5	0.22
Rehabilitation Hospitals (1)	0	0.00	1	0.65	2	0.10	19	0.95
Dually Certified Skilled Nursing Facilities (2) (a)	406	61.58	441	7.93	352	16.05	608	22.49
Medicare Certified Home Health Agencies (3)	239	0.42	320	0.22	178	0.15	316	0.16

Sources: (1) *American Hospital Association Hospital Statistics*, 1994 (data are for 1993).
(2) *Nursing Home Statistical Yearbook*, 1995 (data are for 1995).
(3) Data provided by the National Association for Home Care for agencies as of January, 1995.
(4) Number of beds from (1) or (2) divided by 1994 state population aged 65 or older from U.S. Department of Commerce *Statistical Abstract*, 1995.

Notes: (a) Dually certified beds are certified for both Medicare and Medicaid patient use.
VDU = Ventilator Dependent Unit.
We are able to include rehabilitation hospitals only.

dually certified[8] nursing home beds per 1,000 elderly residents. Minnesota has the greatest supply of these beds at almost 62 beds per 1,000 state residents aged 65 or older; Illinois has the lowest supply at almost eight beds per 1,000.

B. Patient Characteristics

The patients from three of the four VDUs are very similar in age (see Exhibit 7.5). Mayo patients have a mean age of 73.4 (s.d. 8.4 years), RMS patients have a mean age of 73.6 (s.d. 10.8 years), and Sinai patients have a mean age of 74.6 (s.d. 9.5 years). Temple patients are somewhat younger than patients from the other three VDUs, with a mean age of 68.4 (s.d. 11.7 years).

[8] Dually certified nursing home beds are certified for both Medicare and Medicaid residents.

Exhibit 7.5

Age of Patients with Medicare Part A Claims
By Patient Population

	Ventilator Dependent Units				UCDSS
	Mayo	RMS	Sinai	Temple	Sample
n	59	104	22	70	429
mean age	73.4	73.6	74.6	68.4	72.2
s.d.	8.4	10.8	9.5	11.7	9.8

Source: Lewin-VHI analysis of Medicare Part A claims data.
UCDSS=Uniform Clinical Data Set System.

The patients from the four VDUs are less similar in sex and race than in age (see Exhibit 7.6).[9] Mayo has the largest proportion of male patients (36 out of 59) while RMS has the largest proportion of female patients (52 out of 104) (although sex for almost 14 percent of RMS patients is unknown). Patients from the four VDUs are even less similar in race. Nearly all Mayo's patients were white (57 out of 59) while less than one-half of Temple's patients were white (33 out of 70). The differences in race across VDUs may reflect the location of the VDU. For instance, Temple University Hospital is in Philadelphia's inner city and Sinai is in Detroit. In contrast, RMS is in a suburb of Chicago and Mayo is in Rochester, Minnesota, a medium-sized city.

Patients in the UCDSS sample had a mean age of 72.2 (s.d. 9.8 years). UCDSS sample patients were almost evenly divided between males and females. A larger proportion of patients in the UCDSS sample were white (73.7%).

[9] There are a proportion of patients with missing data on sex and race. For instance, almost one-fourth of Sinai VDU patients are missing codes for sex and/or race.

Exhibit 7.6

Sex and Race of Patients with Medicare Part A Claims By Patient Population

	Ventilator Dependent Units								UCDSS Sample	
	Mayo		RMS		Sinai		Temple			
Characteristic	No.	%	No.	%	No.	%	No.	%	No.	%
Sex										
Male	36	61.0%	38	36.5%	9	40.9%	38	54.3%	211	49.2%
Female	22	37.3%	52	50.0%	8	36.4%	29	41.4%	218	50.8%
Unknown	1	1.7%	14	13.5%	5	22.7%	3	4.3%	0	0%
	59	100%	104	100%	22	100%	70	100%	429	100%
Race										
White	57	96.6%	84	80.8%	12	54.5%	33	47.1%	316	73.7%
Non-White	0	0%	5	4.8%	5	22.7%	34	48.6%	53	12.4%
Unknown	2	3.4%	15	14.4%	5	22.7%	3	4.3%	60	14%
	59	**100%**	**104**	**100%**	**22**	**100%**	**70**	**100%**	**429**	**100%**

Source: Lewin-VHI analysis of Medicare Part A claims data.

C. Weaning Status at Discharge

We also examined weaning status for the study of patients. Weaning status was measured at discharge from the VDU for VDU patients and at discharge from the hospital for UCDSS sample patients[10] (see Exhibit 7.7).

A larger proportion of patients from the four VDUs were weaned at discharge from the VDU compared to those dependent on a ventilator. Almost one-half of Mayo patients were weaned at discharge from the VDU (29 out of 59) compared to Sinai VDU patients where only six out of 22 patients left the VDU weaned. The number of VDU patients fully dependent on the ventilator ranged from 5 out of 22 patients for Sinai to 2 out of 59 patients for Mayo and 2 out of 70 patients for Temple.

Almost half of the patients in the UCDSS sample were deceased at discharge from the hospital. Of 429 patients in the UCDSS sample, 167 were weaned while 43 patients were fully dependent on a ventilator at discharge from the hospital.

[10] If a patient was readmitted to the hospital from the VDU and then readmitted to the hospital and then readmitted to VDU, weaning status may not have been measured until the end of the discharge from the second VDU service episode.

Exhibit 7.7

Distribution of Patients by Weaning Status at Discharge By Patient Population

Weaned at Discharge (a)	Ventilator Dependent Units								UCDSS Sample	
	Mayo		RMS		Sinai		Temple			
	No.	%	No.	%	No.	%	No.	%	No.	%
Weaned	29	49%	40	38%	6	27%	22	31%	167	39%
Deceased	5	8%	29	28%	5	23%	7	10%	201	47%
Full Dependence on Ventilator	2	3%	9	9%	5	23%	2	3%	43	10%
Uses Ventilator-Amount Unknown	1	2%	1	1%	0	0%	3	4%	0	0%
Missing	15	25%	18	17%	4	18%	26	37%	9	2%
Total	59	100%	104	100%	22	100%	70	100%	429	100%

Source: Lewin-VHI analysis of Medicare Part A claims data.

Notes: VDU-ventilator dependent unit.

UCDSS-Uniform Clinical Data Set System.

(a) The weaning status measure was taken at discharge from the VDU for VDU patients and at discharge from the hospital for UCDSS sample patients. If a VDU patient was readmitted to the hospital from the VDU and returned to the VDU, the weaning status may apply to the VDU readmission, rather than to the original VDU service episode.

IV. FINDINGS FOR ALL PATIENTS

In this section we examine post-acute care for all patients in the study. We use the term "service day" to refer to a day for which the patient received a service paid under Medicare Part A. We examine the distribution of service days by type of Medicare Part A claims by patient population. We then examine the distribution of service episodes by patient population. Finally, we examine the proportion of patients who died by the end of their Part A claims.

A. Distribution of Service Days Represented by Type of Medicare Part A Claims by Patient Population

Mayo VDU patients spent the largest proportion of their service days represented by Medicare Part A claims in the study period in the acute hospital (43%) (see Exhibit 7.8). The Mayo VDU patients spent 16 percent of their service days in the VDU.[11] Mayo VDU patients spent 59 percent of their service days in the hospital setting when acute hospital days and VDU days are combined (43% + 16% = 59%). Mayo VDU patients spent 29 percent of their

[11] Eighteen Mayo patients were admitted to the VDU prior to the demonstration start. This may account for the lower percentage of time Mayo patients spent in the VDU.

service days in home health care and an equal proportion of service days in a SNF or rehabilitation (6%).

RMS VDU patients, on average, spent the largest proportion of their service days represented by Part A claims in the study period in the VDU (32%) with approximately one-fourth of their service days spent in the acute hospital (27%) (see Exhibit 7.8). RMS VDU patients spent over one-half of their service days in a hospital setting, when one adds their hospital days and their VDU service days (27% + 32% = 59%). RMS VDU patients spent approximately one-fifth of their service days in home health care (24%) and spent an additional 13 percent of their service days in a SNF. RMS VDU patients spent the remaining 5 percent of their service days in rehabilitation (2%), long-term care hospitals (1%) and receiving hospice services (2%).

Exhibit 7.8

Distribution of Total Service Days in the Study Period
By Type of Part A Claim
By Patient Population

Setting	Ventilator Dependent Units (VDU)				UCDSS Sample
	Mayo	RMS	Sinai	Temple	
Acute Hospital	43%	27%	45%	34%	51%
VDU	16%	32%	33%	24%	N/A
SNF	6%	13%	7%	8%	9%
Rehabilitation	6%	2%	1%	3%	1%
Long-Term Care Hospital	0%	1%	2%	0%	5%
Home Health Care	29%	24%	12%	29%	34%
Hospice	0%	2%	0%	1%	0%
TOTAL %	100%	101%	100%	99%	100%
TOTAL SERVICE DAYS	7558	17,438	3,024	12,107	56,606
TOTAL PATIENTS	59	104	22	70	431

Source: Lewin-VHI analysis of Medicare Part A claims data.

Notes: UCDSS=Uniform Clinical Data Set System.

The term "setting" describes the type of health care facility where a patient received care or services a patient received.

Patients from the Sinai VDU on average, spent the greatest proportion of their service days represented by Part A claims in the study period in the acute hospital and spent one-third of their days, on average in the VDU (33%) (see Exhibit 7.8). Sinai VDU patients spent almost four-fifths of their service days in a hospital setting when one adds acute hospital days to VDU days (45% + 34% = 79%). Sinai VDU patients spent most of their remaining service days in

home health care (12%). Less than 10 percent of Sinai VDU patients' service days in the study period were spent in other post-acute settings.

Temple VDU patients spent the greatest proportion of their service days in the study period in the acute hospital (34%) with an additional 24 percent spent in the VDU. Temple VDU patients spent a total of 58 percent of their service days in the hospital setting (when one adds their acute hospital days to their VDU days (34% + 24% = 58%). They spent an additional 29 percent of their service days in home health care and 7 percent of service days in a SNF. They spent less than 5 percent of service days in rehabilitation (3%) or with hospice services (1%).

Patients from the UCDSS sample spent more than half of their service days in the study period in the acute hospital (51%). These patients spent more than one-third of their service days in the study period with home health care (34%), less than one-tenth in a SNF (9%), and only 1 percent of their days in the study period in rehabilitation. Patients from the UCDSS sample spent 5 percent of their service days in the study period in a long-term care hospital.

B. Similarities and Differences in the Distribution of Service Days Among Patients

Patients from the four VDUs were similar in spending the smallest proportion of their service days represented by Part A claims in the study period with hospice services (from 0% to 2%) (see Exhibit 7.8). They also were similar in spending a small proportion of their service days in the study period in long-term care hospitals (from 0% to 2%) and in rehabilitation (1% to 6%). Patients from three of the four VDUs (Mayo, Sinai, and Temple) were also similar in spending less than 10 percent of their service days in the study period in a SNF (6% to 8%). In contrast, RMS VDU patients spent 13 percent of their service days in the study period in the SNF. Patients from three of the four VDUs (Mayo, RMS, and Temple) spent from 24 percent to 29 percent of their service days in the study period in home health care. In contrast, patients from Sinai VDU spent 12 percent of their days in home health care. The amount of service days represented by Part A claims in the study period that patients from the four VDUs spent in the acute hospital or the VDU vary widely from VDU to VDU. The proportion of service days represented by Medicare Part A claims in the study period spent in the acute hospital varied from 27 percent (RMS VDU) to 45 percent (Sinai VDU). The proportion of service days in the study period spent in the VDU varied from 16 percent (Mayo VDU) to 33 percent (Sinai VDU).

Patients from the UCDSS sample spent a similar proportion of service days in the study period in rehabilitation (1%) and with hospice services (0%) compared to VDU patients. UCDSS sample patients spent a similar proportion of their service days in the study period in a SNF (7%) compared to VDU patients in three of four VDUs. The UCDSS sample patients also spent a similarly small proportion of their service days in the study period in a long-term care

hospital (5%), compared to the VDU patients, although this proportion was higher for UCDSS sample patients.

Patients from the UCDSS sample differed from VDU patients in spending a substantially greater proportion of their service days in the study period with home health care (28% compared to 22% for RMS VDU patients, the highest proportion in home health care among VDUs). UCDSS sample patients also differed from the VDU patients in the proportion of service days in the study period spent in the acute hospital. Patients from the UCDSS spent 51 percent of their service days in the acute hospital (45%). Patients from Sinai VDU and Mayo VDU have a similarly high proportion of service days in the acute hospital (45% and 43%, respectively). However, when one combines the service days spent by VDU patients in the hospital and the VDU, UCDSS sample patients are more similar to Mayo VDU and Temple VDU patients in the proportion of time spent in a hospital setting: UCDSS sample patients spent 51 percent of their service days in the study period in the hospital, while Mayo VDU patients spent 59 percent and Temple VDU patients spend 58 percent of their service days in the hospital setting. RMS VDU patients and Sinai VDU patients spent a greater proportion of their days in the hospital setting than UCDSS sample patients, at 59 percent and 78 percent, respectively.

C. Total and Average Service Episodes for Patients in VDU Units and from the UCDSS Sample

We defined a "service episode" as one or more days in a "setting." We defined "setting" as the type of facility where a patient received care or services. Gaps in services were counted as service episodes to allow us to count the number of times a patient moved from one setting to another.

We examined the total and average number of service episodes during the study period for all patients with Part A claims (see Exhibit 7.9). The average number of service episodes per VDU patient during the study period varied widely for the four VDU units, from an average of 3 service episodes for Sinai VDU patients to an average of 7 service episodes for Temple patients.

Patients from the UCDSS sample had an average of three service episodes during the study period (see Exhibit 7.9). This average number of service episodes for UCDSS sample patients is lower than the average for patients from any VDU, except Sinai. However, UCDSS sample patients automatically have one less service episode than VDU patients because they were not in a VDU. If we add one service episode to the UCDSS sample patient average in order to compare average service episodes, UCDSS sample patients still have fewer service episodes, on average, than patients from three of the four VDUs. Sinai VDU again is the exception with an average of 3 service episodes per patient in the study period.

Exhibit 7.9

Total Service Episodes and Average Service Episodes Per Patient For All Patients With One or More Part A Claims In The Study Period: Ventilator Dependent Units and UCDSS Sample

Patient Source	Total Patients (a)	Total Number of Service Episodes	Average Service Episodes Per Patient
VDU Unit			
Mayo	59	325	5
RMS	104	501	5
Sinai	22	73	3
Temple	70	488	7
UCDSS Sample	431	1361	3

Source: Lewin-VHI analysis of Medicare Part A Claims.

Notes: The term "service episode" is one or more days in a "setting." We defined a "setting" as the type of facility where a patient received care or services the patient received.

(a) Includes all patients who had Part A claims data during the study period.

VDU= ventilator dependent unit.

UCDSS= Uniform Clinical Data Set System.

D. Patients Who Died During the Study Period

We used the claims data to determine whether a patient died,[12] by the end of their last claim or the end of the time claims were collected (Exhibit 7.10). Mayo VDU patients had the lowest proportion of patients who died by the end of their last claim in the study period (18 out of 60) among the four VDUs while RMS had the highest proportion (64 out of 104).

Sixty-five percent of patients in the UCDSS sample died by the end of their last claim in the study period (282 out of 431). The percentage of patients in the UCDSS sample who died is similar to the percentage of RMS VDU patients who died by the end of their last claim in the study period (UCDSS = 65% died; RMS VDU = 62% died).

[12] The discharge destination of the last Part A claim in the study period was used to determine if a patient died by the end of the study period. The outcomes analysis used a different source for patient death.

Exhibit 7.10

Percentage of Patients Who Died
Ventilator Dependent Units and UCDSS Sample

Patient Source	Total Patients (a)	Number of Patients Who Died In the Study Period (b)	Percentage of Patients Who Died In the Study Period (b)
VDU Unit			
Mayo	59	19	32%
RMS	104	64	62%
Sinai	22	11	50%
Temple	70	27	39%
UCDSS Sample	431	282	65%

Source: Lewin-VHI analysis of Medicare Part A Claims.
VDU= Ventilator Dependent Unit.
UCDSS= Uniform Clinical Data Set System.

(a) Includes all patients who had Part A claims data during the study period.

(b) The discharge destination of the last Part A claim in the study period was used to determine if a patient died by the end of the study period.

V. Post-Acute Care For Patients Who Survived Their First Time in The Hospital Setting

In this section we focus on patients who were alive at discharge or survived their first service episode in the hospital setting, either the combination of the first acute hospital service episode and VDU service episode or, for the patients from the UCDSS sample, the first hospital service episode. We examined the proportion of patients who had a post-acute episode. We also examined the number of post-acute service episodes per patient, changes in post-acute settings, and readmissions[13] to the acute hospital. We also examined readmissions to the VDU for VDU patients.

Most patients discharged alive from the VDU had at least one post-acute service episode (see Exhibit 7.11). Of the four VDUs, the RMS VDU had the largest proportion of patients who had one or more post-acute service episodes (68 out of 75), while the Mayo VDU had the smallest proportion of patients with at least one post-acute service episode (34 out of 52).

All of the UCDSS sample patients had at least one post-acute service episode (n = 247).

---

[13] "Readmission" is used to denote a subsequent admission to a setting.

Exhibit 7.11

Patients With and Without At Least One Part A Post-Acute claim in the Study Period

Patient Source	Total Patients Alive at Discharge (a)	Patients Alive at Discharge With At Least 1 PAC Claim (b)	Patients Alive at Discharge With No PAC Claims (c)
VDU Unit			
Mayo	52	34 (65%)	18 (35%)
RMS	75	68 (91%)	9 (9%)
Sinai	16	12 (75%)	4 (25%)
Temple	60	51 (85%)	9 (15%)
UCDSS Sample	247	247 (100%)	0 (0%)

Source: Lewin-VHI analysis of Medicare Part A Claims.

Notes: (a) Patients alive at discharge from ventilator dependent unit (VDU) or from hospital if a patient is in the UCDSS sample.

(b) Patients alive at discharge who had one or more claim after discharge or from the VDU from the hospital.

PAC= post-acute care or care following discharge from the VDU (or hospital for UCDSS sample patients).

(c) Patients alive at discharge who had no post-acute claims.

VDU= ventilator dependent unit.

UCDSS= Uniform Clinical Data Set System.

A. Post-Acute Service Episodes and Setting Changes for Patients Who Survived Their First Discharge From the Hospital Setting

We examined the number of post-acute service episodes[14] per patient and changes in post-acute settings after discharge from the hospital setting for all patients alive at discharge (Exhibit 7.12). Patients from the Sinai VDU had the lowest mean number of service episodes[15] per patient at 2.3 (s.d. 2.7) while Temple VDU patients had the highest mean number of service episodes per patient at 6.0 (s.d. 4.6) during the study period.

UCDSS sample patients had a mean number of 3.7 service episodes (s.d. 4.1) (see Exhibit 7.12). In this case patients from the UCDSS sample and VDU patients were directly comparable because only post-acute service episodes were considered. UCDSS sample patients' average number of service episodes (mean = 3.7, s.d. = 4.1) is similar to RMS VDU patients' average number of service episodes (mean = 3.7, s.d. = 3.1).

---

[14] We have defined a "service episode" as one or more days in a "setting." We have defined a "setting" as the type of facility where a patient received care or services. We have included gaps in services as a service episode to allow us to count changes in settings.

[15] Gaps in service were considered as a setting in this analysis.

The largest number of setting changes was 24 for one Mayo patient (23 of these settings were after the first VDU service episode). Although Temple VDU patients had the largest mean number of post-acute service episodes in the study period, they did not have the most setting changes. One Temple VDU patient had 18 setting changes during the study period (17 of these setting changes were after the first VDU service episode). One RMS VDU patient had 14 setting changes and one Sinai VDU patient had 11 setting changes. Two patients from the UCDSS sample had 20 post-acute setting changes during the study period.

Exhibit 7.12

Mean Number of Post-Acute Service Episodes and Changes in Settings During the Study Period for Patients From Ventilator Dependent Units and UCDSS Sample

Patient Source	Total Patients Alive at Discharge With One or More PAC Service Episodes (a)	Mean Post-Acute Stays per Patient Alive at Discharge With One Or More PAC Service Episode	Standard Deviation	Maximum Number of Setting Changes (b)
VDU Unit				
Mayo	34	4.44	4.1	24
RMS	68	3.69	3.1	14
Sinai	12	2.33	2.7	11
Temple	51	6.00	4.6	18
UCDSS sample	247	3.73	4.1	20

Source: Lewin-VHI analysis of Medicare Part A Claims.

Notes: (a) Includes VDU patients alive at discharge from the VDU unit and patients from the UCDSS sample who were alive at discharge from the hospital and who had one or more claim after discharge from the VDU or hospital.

(b) Maximum number of times one patient from that patient population changed settings during the study period.

The term "setting" describes the type of health care facility where a patient received care or services a patient received.

The term "service episode" describes one or more days in a setting.

VDU = Ventilator Dependent Unit.

UCDSS= Uniform Clinical Data Set System.

B. Hospital Readmissions for Patients Who Survived their First Discharge From the Hospital Setting

In this section we discuss readmission[16] to the acute hospital or readmission to the VDU. We also use the term "rehospitalization" in the same way we use the term "readmission to the hospital."

A large proportion of patients had an acute rehospitalization during their post-acute service episode (see Exhibit 7.13). The VDU patients alive at discharge from the VDU who had at least one readmission to the acute hospital ranged from more than one-half of Sinai patients (9 out of 16) to four out of five of Temple patients (48 out of 60).

Exhibit 7.13

Patients Alive at Discharge With and Without Readmissions[17]
During the Study Period
Ventilator Dependent Units and UCDSS Sample

Patient Source	Total Patients Alive at Discharge (a)	Patients With Acute Hospital Readmissions (b)		Patients Without Acute Hospital Readmissions		Patients With VDU Readmissions (c)		Patients Without VDU Readmissions	
VDU Unit		**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Mayo	52	34	65%	18	35%	10	19%	42	81%
RMS	75	48	64%	27	36%	10	13%	65	87%
Sinai	16	9	56%	79	44%	3	19%	13	81%
Temple	60	48	80%	12	20%	29	48%	31	52%
UCDSS Sample	247	117	47%	130	53%	N/A		N/A	

Source: Lewin-VHI analysis of Medicare Part A Claims.

Notes: (a) Includes VDU patients alive at discharge from the VDU and patients from the UCDSS sample alive at discharge from the hospital.

(b) Patients readmitted to the acute hospital during the study period.

(c) Patients readmitted to the VDU during the study period.

VDU= ventilator dependent unit.

UCDSS= Uniform Clinical Data Set System.

Of the 52 patients discharged alive from Mayo VDU at their first VDU discharge, 34 patients had one or more readmissions to the acute hospital in the study period. These 34 patients had a total of 74 readmissions to the hospital during the study period. Ten Mayo

[16] A readmission is an admission to a facility that is subsequent to the first admission to that facility.

[17] Readmission = an admission to a facility that is subsequent to the first admission to that facility.

patients alive at discharge from the VDU had a readmission to the VDU during the study period.

Of the 75 patients discharged alive from the RMS VDU at their first VDU discharge, 48 patients had one or more readmission to the acute hospital in the study period. These 48 patients had a total of 84 hospital readmissions. Ten RMS patients alive at discharge from their first VDU stay had a readmission to the VDU during the study period.

Of the 16 patients discharged alive from the Sinai VDU at their first VDU discharge, nine patients had one or more readmissions to the hospital in the study period. These nine patients had a total of 11 hospital readmissions during the study period. Three Sinai patients had a VDU readmission in the study period.

Of the 60 patients discharged alive from the Temple VDU at their first VDU discharge, 48 patients had one or more hospital readmissions in the study period. The 48 patients had a total of 110 readmissions in the study period. Twenty-nine patients had a VDU readmission in the study period.

A number of patients in the UCDSS sample also had hospital readmissions in the study period. Of the 247 patients discharged alive from their first hospital service episode, 117 patients (47.4%) had one or more hospital readmissions in the study period. These 117 patients had a total of 243 hospital readmissions in the study period.

IV. Post-Acute Care Patterns By VDU Unit

In this section we discuss patterns of post-acute care. We discuss the VDU units in alphabetical order and use flow charts so that the reader can visualize the post-acute patterns of care. We focus on the beginning of the post-acute care pattern because there does not seem to be much of a discernible pattern after the first few settings for most patients. For this analysis of post-acute patterns in the four VDU units, we include in the analysis only VDU patients who were in the acute hospital and then had a service episode in the VDU and refer exclusively to these patients in this section. We use the term post-acute to describe any service episode following discharge from the first service episode in the VDU. At the end of this section we discuss consistencies in patterns of post-acute care across the four VDUs.

A. Mayo VDU Patients' Patterns of Post-Acute Care

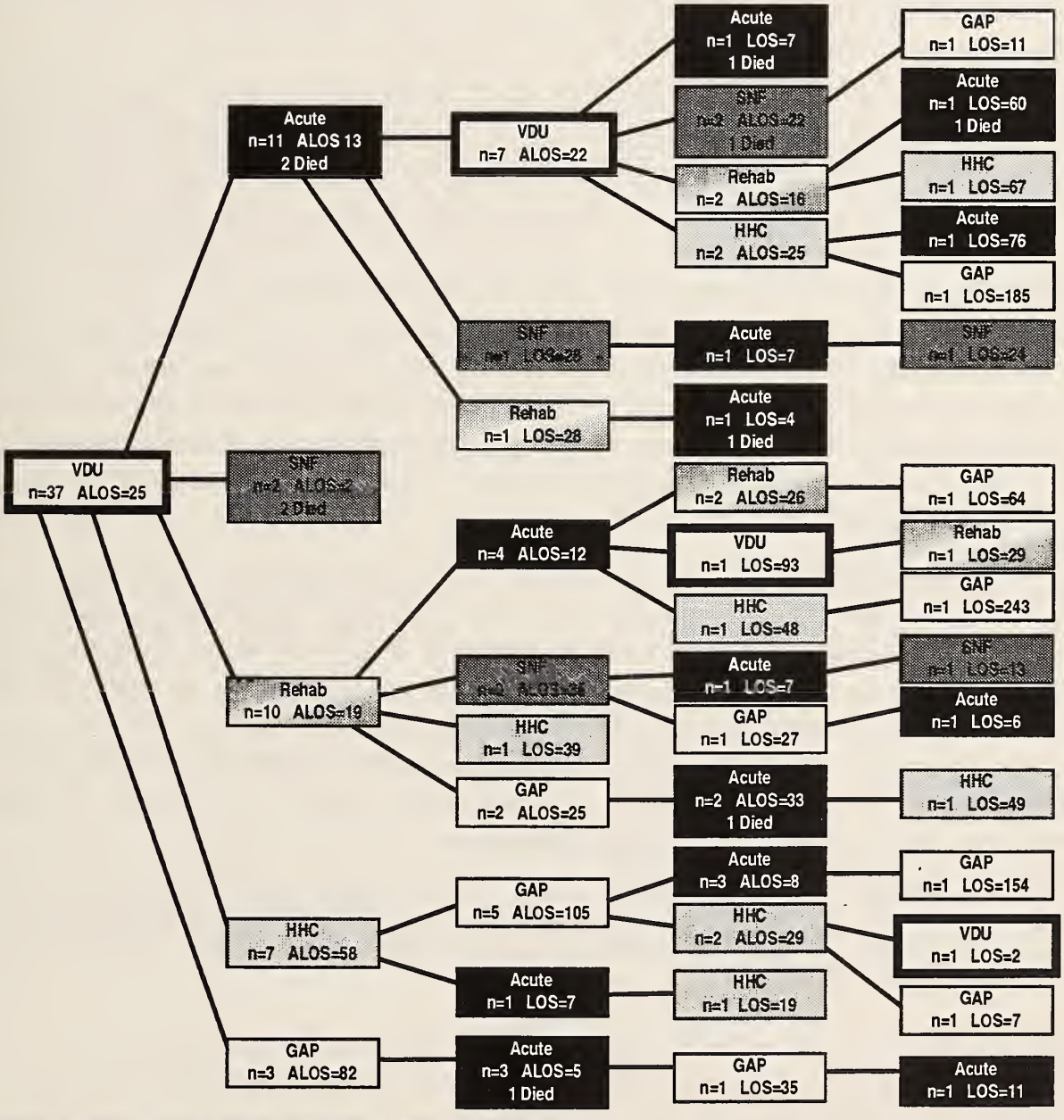
Thirty-seven patients were admitted to the Mayo VDU from the acute hospital where they had an average length of stay (ALOS) of 25 days (see Exhibit 7.14). Four changes in settings following the VDU service episode are shown in the flow chart.[18] The most common post-acute pattern for Mayo VDU patients was a readmission to the acute hospital followed by a readmission to the VDU.

---

[18] In preparing the flow charts we found that little was revealed by showing more than the four post-acute settings since the patterns of post-acute care generally became individualized after the second post-acute setting.

Exhibit 7.14

First Four Post-Acute Settings For Patients Who Went from the Acute Hospital to the Mayo VDU[19]



Source: Lewin-VHI analysis of Medicare Part A claims data.

---

[19] The patients whose first four post-acute settings are shown in this flowchart were ventilated in the acute hospital and were discharged from the hospital to the Mayo VDU.

The first discharge destination for Mayo VDU patients was most commonly an acute hospital. Almost one-third of Mayo patients who survived their first VDU service episode were rehospitalized directly following their first VDU service episode (11 out of 37). Two patients died during this rehospitalization. Of the remaining nine patients, seven were readmitted to the VDU directly from the hospital. Of the 11 patients rehospitalized after their first VDU service episode, all but three either died or were rehospitalized again before the end of the fourth post-acute service episode.

Ten Mayo VDU patients (out of 37) had a rehabilitation hospital or unit as their first discharge destination.[20] Out of these 10 patients, one patient had no further claims; another went to home health care from rehabilitation and had no further Part A claims. Two of the 10 patients admitted to rehabilitation post-acute settings were readmitted to the hospital and returned to rehabilitation; another two patients went from the rehabilitation setting to a SNF, while an additional two patients went from the rehabilitation setting to a gap in service, followed by a hospital readmission. Most patients discharged from the VDU to a rehabilitation setting ultimately had a rehospitalization prior to the end of the fourth post-acute setting (8 out of 10); one half of those patients were rehospitalized directly from the rehabilitation setting (4 out of 8). The only other pattern that is discernible for patients discharged from the Mayo VDU to a rehabilitation setting is that, despite the number of rehospitalizations, only one patient died before the end of their Part A claims.[21]

Rehospitalization was the most common pattern for Mayo patients discharged from the VDU to other post-acute settings as well. In fact, most Mayo patients discharged from the VDU had a rehospitalization some time prior to the end of the fourth post-acute setting (26 out of 37). All patients with a gap in service following their first VDU service episode (3 out of 37) and a majority of patients discharged to home health care from the VDU (4 out of 7) had a rehospitalization. None of the Mayo patients discharged from the VDU to home health care died by the end of their Part A claims. Both patients discharged to a SNF (2 out of 37) did not have rehospitalizations because they died in the SNF.

Four Mayo VDU patients started with an acute hospital service episode followed by a VDU service episode, were discharged alive from the VDU, and had no further Part A claims during the study period.

---

[20] Eighteen Mayo patients were admitted to the VDU prior to the start of the demonstration. It is possible that the provider number code for these patients indicated that the patient went to a rehabilitation setting when they really were in the VDU.

[21] We use the terminology "died before the end of their claims" because we used the discharge destination from the last claim as the measure of death in the post-acute portion of this study. In the outcomes analysis portion of the study a different source of death is used.

B. RMS VDU Patients' Patterns of Post-Acute Care

For most RMS patients discharged alive from the VDU (73 out of 93), their first discharge destination was a SNF. Approximately equal numbers of RMS VDU patients went to home health care, a rehabilitation setting, or back to the hospital for their first post-acute service episode (see Exhibit 7.15).

The most common first post-acute discharge destination for the RMS VDU patients was a SNF (23 out of 73). Ten of these 23 patients had no further Medicare Part A claims following their SNF service episode. About one-half of the patients discharged from the VDU to the SNF returned to a hospital (11 out of 23) and were subsequently readmitted to a SNF (10 out of 11). The remaining patients (n = 2) were discharged from the SNF to home health care from which they had a subsequent acute rehospitalization.

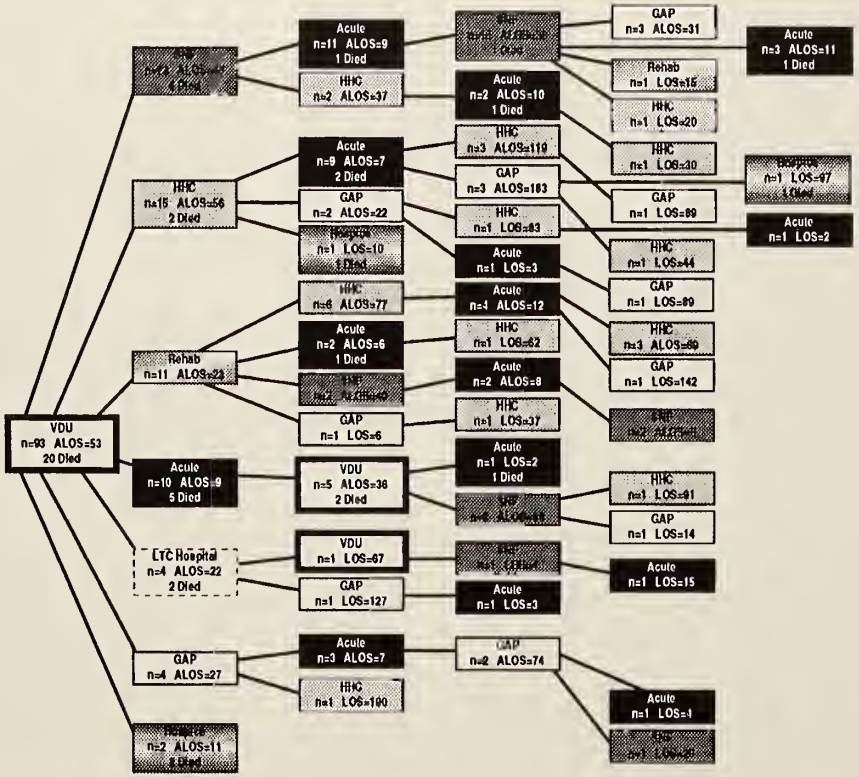
The second most common first post-acute discharge destination for the RMS VDU patients was home health care (15 out of 73). A majority of these patients were readmitted to a hospital from home health (9 out of 15) where two patients died. Three of the surviving patients returned to home health after their hospital readmission, three had a gap in service and one patient had no further Part A claims during the study period. Of the four patients who were not rehospitalized after their first home health service episode, one had no further Part A claims, two had a gap in service and one was one of the few patients to go to a hospice. Virtually all patients discharged from the RMS VDU to home health care had a rehospitalization by the end of four post-acute settings (11 out of 12). By the end of the study period, more than one-third of the RMS patients discharged from the VDU to home health care died (6 out of 15).

The third most common first post-acute discharge destination for the RMS VDU patients was a rehabilitation setting (11 out of 73). About one-half of the RMS patients discharged from the VDU to rehabilitation were subsequently discharged to home health care (6 out of 11). Of the remaining five patients, two were rehospitalized, two were discharged to a SNF, and one patient had a gap in service. The majority of patients discharged from the VDU to a rehabilitation facility had a subsequent rehospitalization (8 out of 11). By the end of the study period, three out of 11 RMS patients discharged from the VDU to a rehabilitation setting died.

The fourth most common first post-acute discharge destination for RMS VDU patients was an acute hospital (10 out of 75). One-half of these patients returned to the VDU from the hospital (5 out of 10) while the other one-half died (5 out of 10). Most of the patients rehospitalized after their first VDU service episode died before the end of the study period (8 out of 10).

EXHIBIT 7.15

FIRST FOUR POST-ACUTE SETTINGS FOR PATIENTS WHO WENT FROM THE ACUTE HOSPITAL TO THE RMS VDU[22]



Source: Lewin-VHI analysis of Medicare Part A claims data.

---

[22] The patients whose first four post-acute settings are shown in this flowchart were ventilated in the acute hospital and were discharged from the hospital to the RMS VDU.

Interestingly, RMS was the only VDU to discharge more than one patient to a long-term care hospital for a first post-acute service episode (4 out of 73). (Of the other three VDUs, Sinai discharged one patient to a long-term care hospital while Mayo and Temple did not discharge anyone to a long-term care hospital during the study period.) Of these four RMS VDU patients, two died in the long-term care hospital, one returned to the VDU and the other had a gap in service followed by rehospitalization.

Three RMS VDU patients started in an acute hospital followed by a VDU service episode, were discharged alive from the VDU, and had no further Part A claims during the study period.

C. Sinai VDU Patients' Post-Acute Patterns of Care

Fourteen patients were discharged from an acute hospital to the Sinai VDU for an ALOS of 55 days (see Exhibit 7.16). As with the other units, four changes in settings following the VDU service episode are shown in the flow chart. We only observed one pattern of post-acute care for Sinai VDU patients: readmission to an acute hospital.

The first discharge destination for patients discharged alive from the Sinai VDU most commonly was an acute hospital (5 out of 14). Two of these patients died in the hospital, two were readmitted to the Sinai VDU and the other patient was discharged to a long-term care hospital.

About one-half of patients from the Sinai VDU with post-acute Part A claims died during the four observed post-acute settings (8 out of 14). Two Sinai VDU patients had a hospital service episode followed by a VDU service episode, were discharged alive from the VDU, and had no further Part A claims. The only Sinai VDU patient without an extended post-acute pattern of service episodes was discharged to a rehabilitation setting from the VDU.

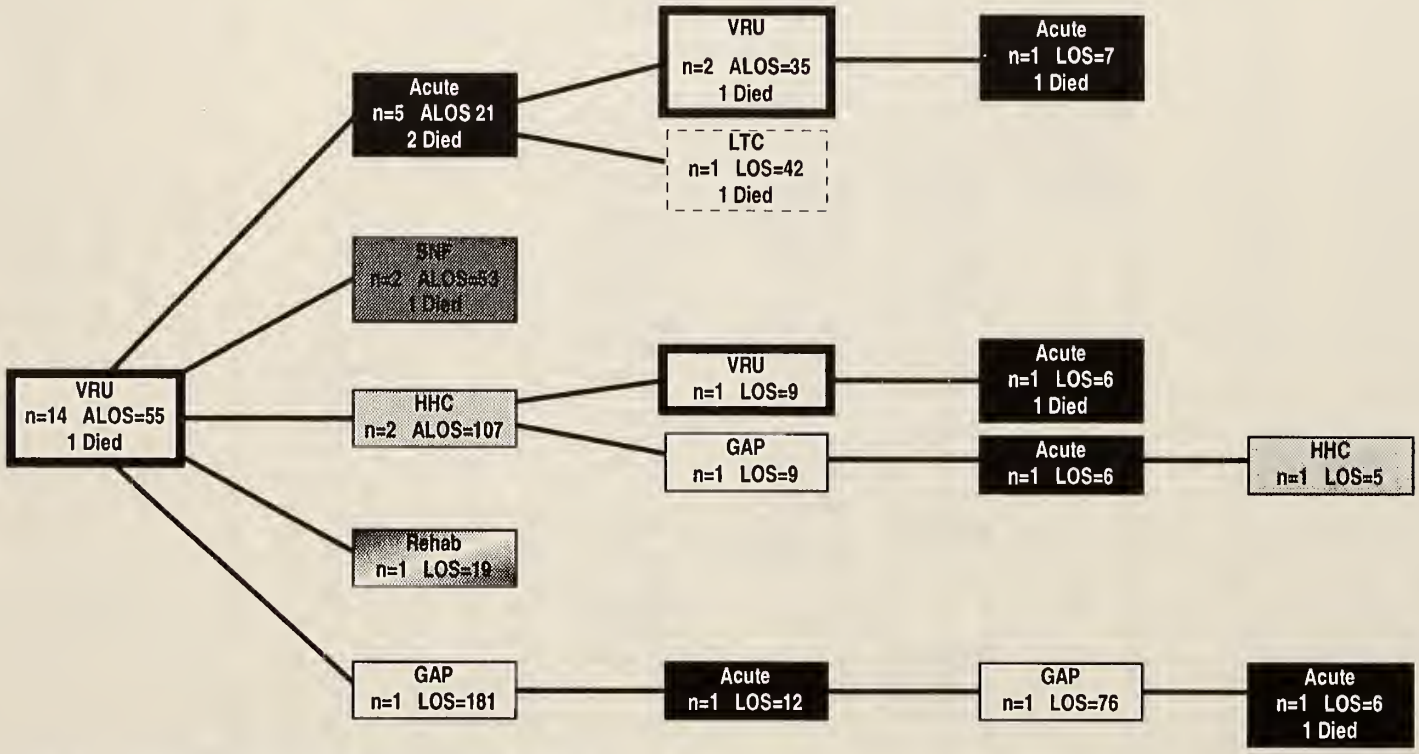
D. Temple VDU Patients' Post-Acute Patterns of Care

Forty-six patients were discharged from an acute hospital to the Temple VDU where they had an ALOS of 31 days (see Exhibit 7.17). Two Temple VDU patients started with an acute hospital service episode followed by a VDU service episode, were discharged alive from the VDU, and had no further Part A claims in the study period.

The first post-acute discharge destination for Temple VDU patients was most commonly an acute hospital (16 out of 46), most of these patients returned to the VDU from the hospital (12 out of 16). After their second VDU service episode, 9 of the 10 patients who survived went to 5 different locations. A majority of the patients who were discharged alive from their second VDU service episode had a subsequent acute rehospitalization during the four observed post-acute settings (7 out of 10) although only one died by the end of fourth post-acute setting. However, one-half of patients admitted to the acute hospital from their first VDU service episode did die before the end of the study period.

Exhibit 7.16

First Four Post-Acute Settings for Patients who went from the Acute Hospital to Sinai VDU[23]



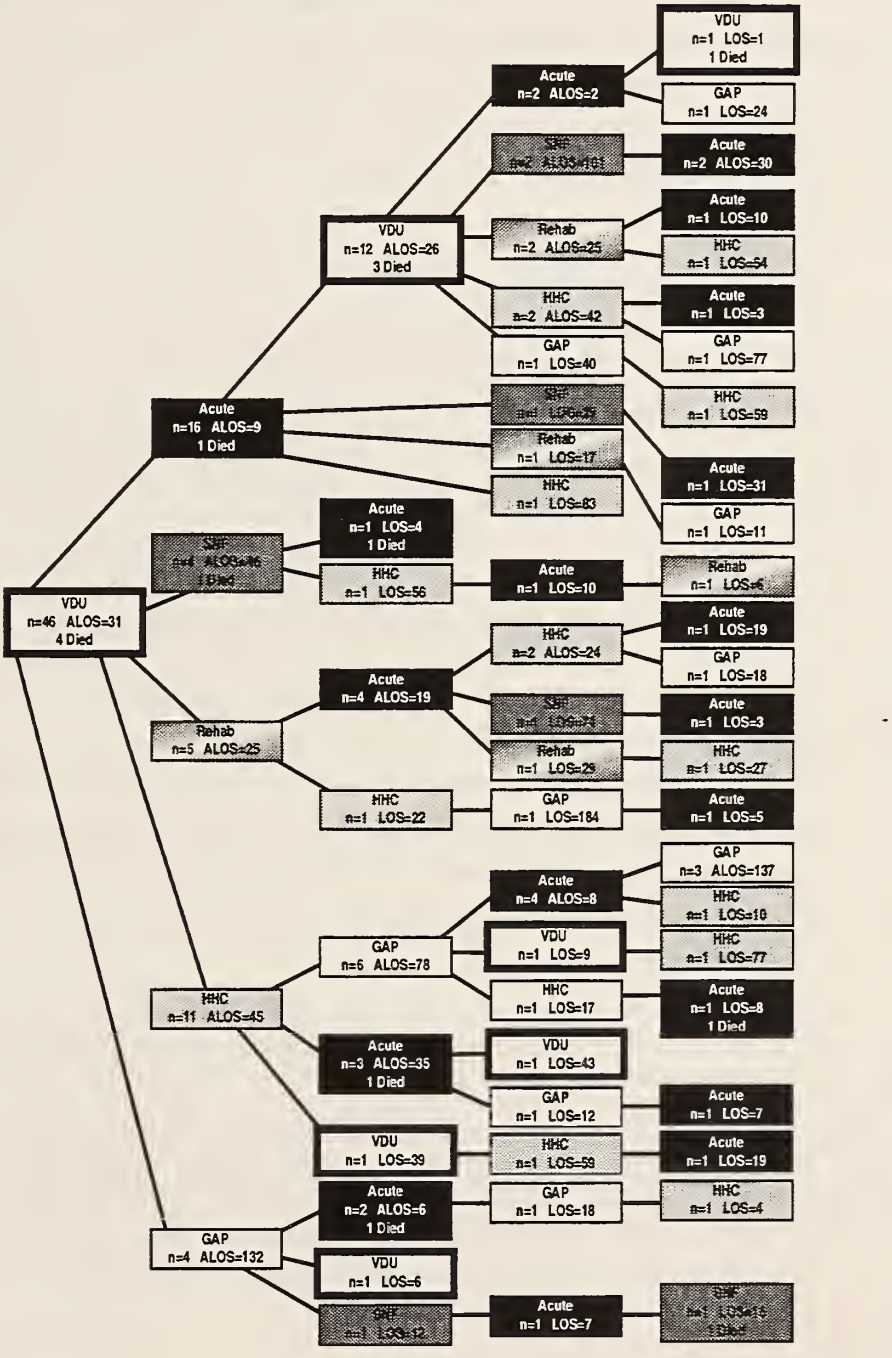
Source: Lewin-VHI analysis of Medicare Part A claims.

---

[23] The patients whose first four post-acute settings are shown in this flowchart were ventilated in the acute hospital and were discharged from the hospital to the Sinai VDU.

EXHIBIT 7.17

FIRST FOUR POST-ACUTE SETTINGS FOR PATIENTS WHO WENT FROM THE ACUTE HOSPITAL TO THE TEMPLE VDU[24]



Source: Lewin-VHI analysis of Medicare Part A claims.

---

[24] The patients whose first four post-acute settings are shown in this flowchart were ventilated in the acute hospital and were discharged from the hospital to the Temple VDU.

The second most common first post-acute discharge destination for Temple VDU patients was home health care (11 out of 46) after which about one-half of the patients had a gap in service (6 out of 11). Most patients with a gap in service at this point had a hospital readmission (4 out of 6); one was readmitted to the VDU. Another three patients discharged from the Temple VDU to home health were rehospitalized before the end of the fourth post-acute setting. In fact, a majority of Temple patients discharged from their first VDU service episode to home health care had an acute rehospitalization before the end of the fourth post-acute care setting (8 out of 11). One patient was discharged from home health and had no further Part A claims in the study period.

An almost equal number of Temple VDU patients were discharged from their first VDU service episode to a rehabilitation setting (5 out of 46), had a gap in service (n=4), or went to a SNF (n=4). All patients discharged from the Temple VDU to a rehabilitation setting had an acute rehospitalization before the end of the four post-acute settings, as did the majority of patients discharged from the VDU to a gap in service (3 out of 4) and one-half of those discharged to a SNF (2 out of 4). However, by the end of their Part A claims, none of these rehabilitation patients had died. One-half of the patients with a gap in service following the first VDU service episode (2 out of 4) and a majority of the SNF patients had died (3 out of 4).

E. Patterns of Post-Acute Care Across All VDU Units

In this section we step back from the detail to discuss the consistencies we found in patterns of post-acute care across the four VDU units.

- Most of the VDU patients move from one post-acute setting to another.
- More than one-half of the ventilator dependent patients discharged from VDU have one or more readmissions to an acute hospital.
- A few of the VDU patients who have an acute hospital readmission also have a readmission to the VDU.
- The post-acute patterns become extremely individualized after two post-acute settings. This pattern of individualization may be a perception resulting from the small number of VDU patients.
- Patients discharged from the VDU to a rehabilitation setting for their first post-acute service episode appear to have high rates of acute hospital readmission, but are not as likely to die prior to the end of their claims as patients in other post-acute settings. Based on the restrictive criteria for admission to a rehabilitation hospital or distinct part unit, we would expect patients discharged to a rehabilitation setting to

be healthier than VDU patients discharged to a SNF and possibly more healthy than patients discharged to home health care.[25]

V. PATTERNS OF POST-ACUTE CARE FOR UCDSS SAMPLE PATIENTS

In our analysis of UCDSS sample patients post-acute patterns we examine the patterns for all patients who survived their first hospital admission in the study period. Because of the number of UCDSS sample patients, we provide three flow charts to illustrate the three most common patterns of first post-acute discharge destination. We show and discuss five post-acute settings for UCDSS sample patients. Overall our examination of the post-acute care patterns for patients from the UCDSS sample indicates that the first discharge destination from the acute hospital often is an indicator of where the patient will go after either acute rehospitalizations or gaps in service. Patients discharged from the hospital to a SNF appear to be more likely to return to a SNF following hospital readmissions and/or a gap in service (see Exhibit 7.18) while patients discharged to home health care are more likely to return to home health care following a hospital readmission and/or a gap in service (see Exhibit 7.19). This pattern also exists for 9 out of 26 patients from the UCDSS sample who survived their first long-term care hospital service episode (see Exhibit 7.20).

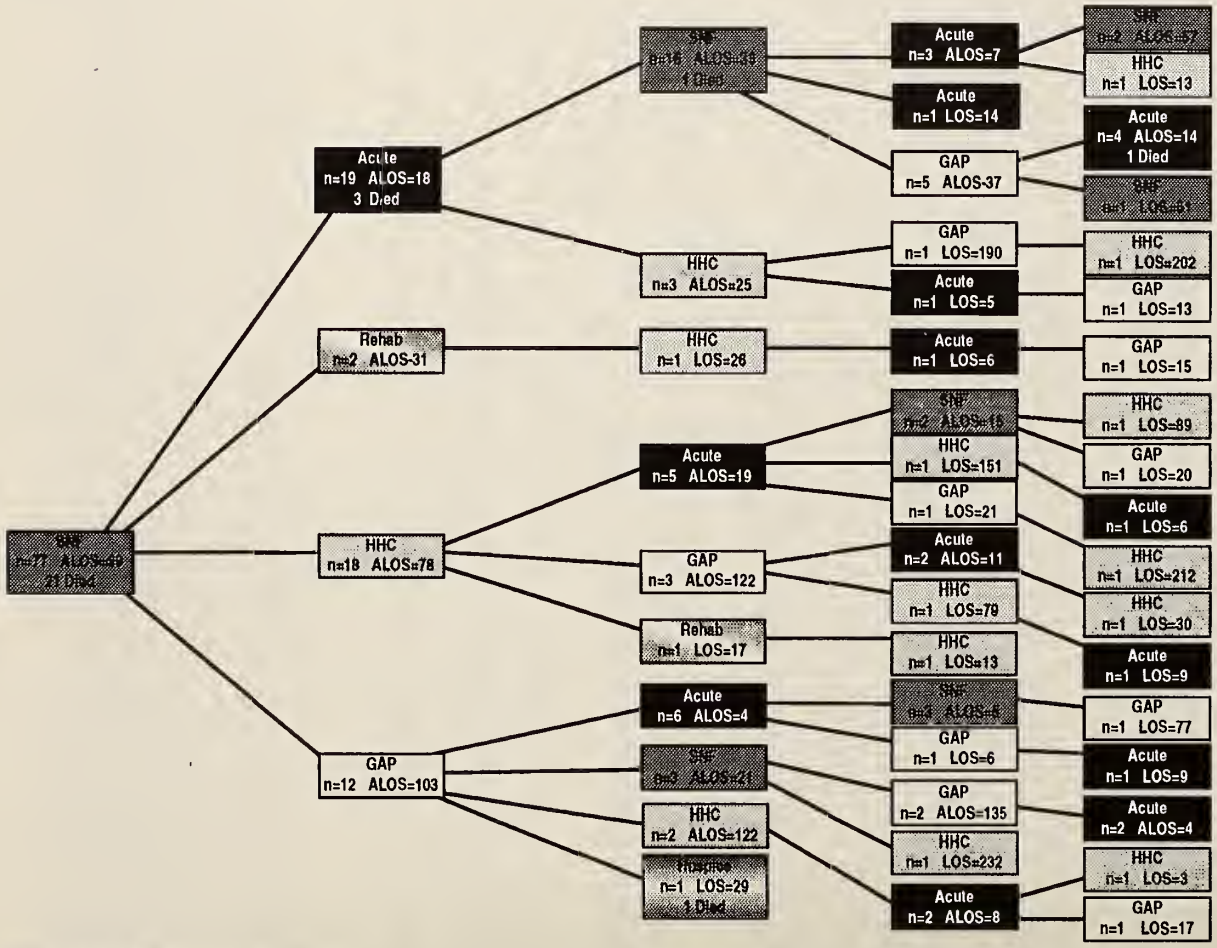
The most frequent first post-acute discharge destination for UCDSS sample ventilator dependent patients was discharge to a SNF (77 out of 247) (see Exhibit 7.17). Almost equal numbers of UCDSS sample patients discharged from the hospital to a SNF died in the SNF (21 out of 77), were readmitted to an acute hospital (19 out of 77) or were discharged to home health care from the SNF (18 out of 77). Another 12 patients had a gap in service following their SNF discharge. Most UCDSS sample patients discharged to an acute hospital from the SNF who survived their rehospitalization service episode returned to a SNF (13 out of 16). A majority of these patients had a subsequent rehospitalization by the end of two more post-

---

[25] In order to be admitted to a rehabilitation hospital or unit, a preadmission screening is normally done. This screening is a "preliminary review of the patient's condition and previous medical record to determine if the patient is likely to benefit significantly from an intensive hospital program or extensive inpatient assessment" (Medicare Intermediary Manual, Section 3101.11, February, 1990). Screening criteria include the following requirements: the patient must require the 24-hour availability of a physician with special training or experience in rehabilitation and rehabilitation nursing and the patient must require (and be capable of receiving) at least 3 hours of physical and occupational therapy 5 days per week or more. There are no such requirements for admission to skilled nursing facilities or home health care.

Exhibit 7.18

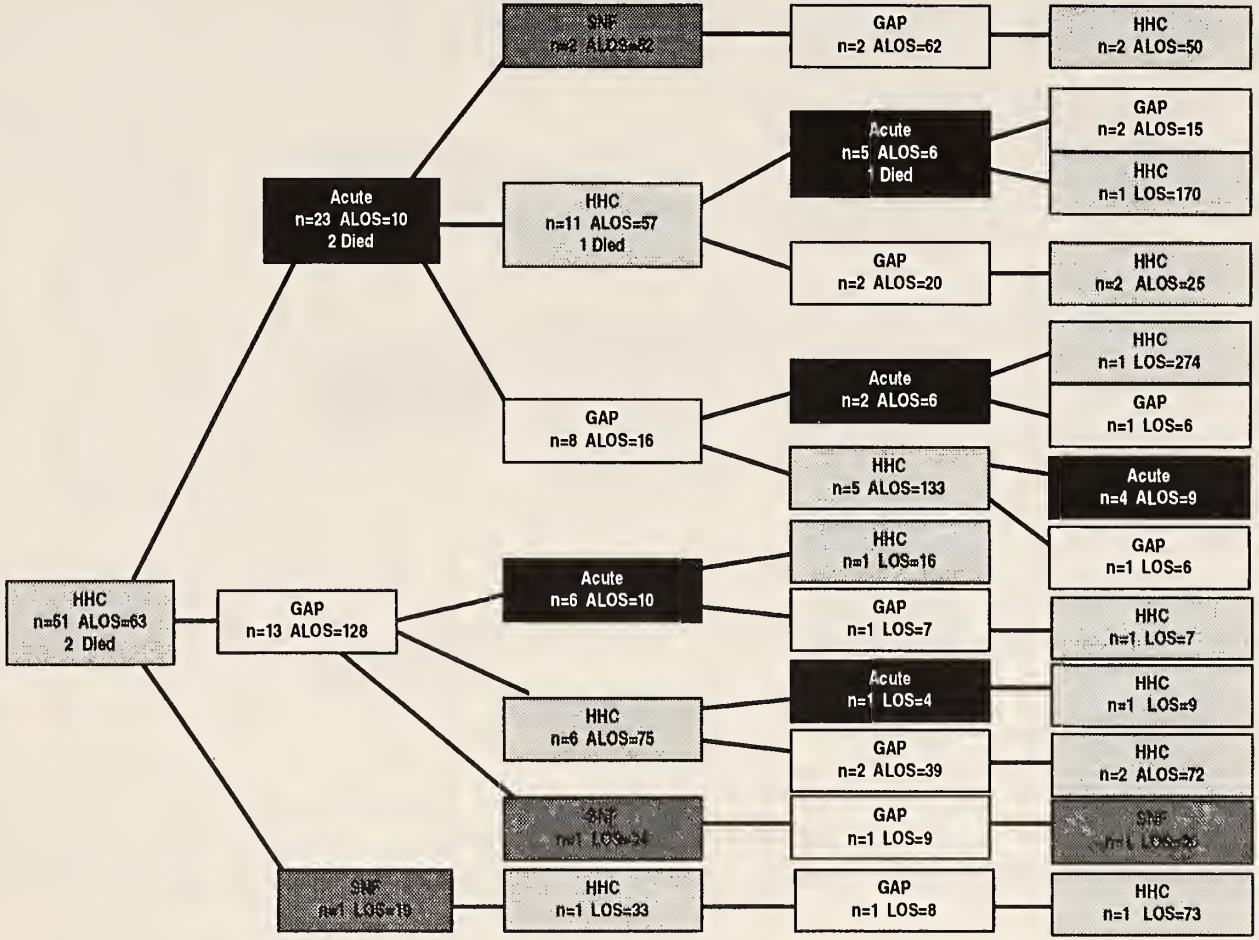
UCDSS Sample Patients Discharged From an Acute Hospital to a Skilled Nursing Facility: 5 Post-Acute Service Episodes



Source: Lewin-VHI analysis of Medicare Part A claims.

Exhibit 7.19

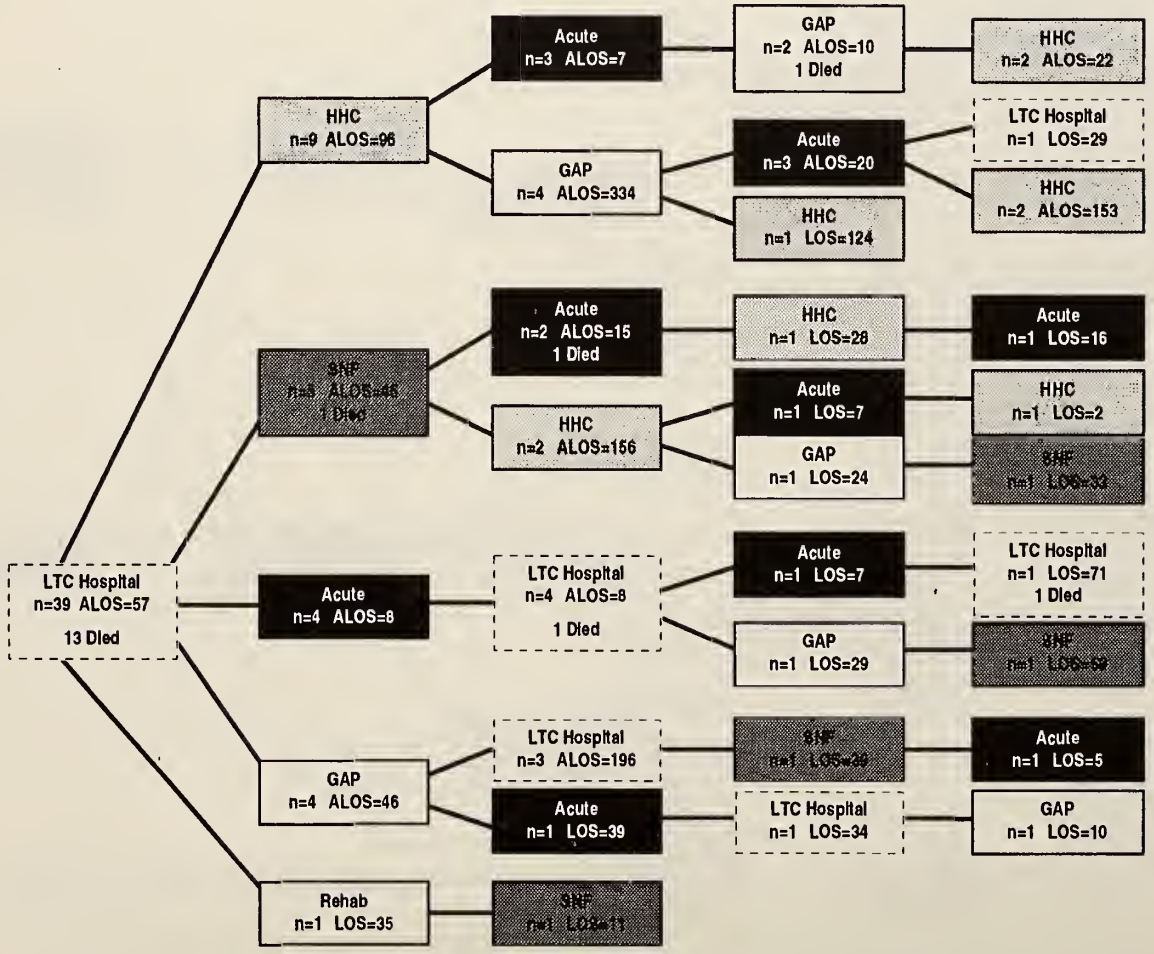
UCDSS Sample Patients Discharged from an Acute Hospital to Home Health Care: 5 Post-Acute Service Episodes



Source: Lewin-VHI analysis of Medicare Part A claims.

Exhibit 7.20

UCDSS Sample Patients Discharged from an Acute Hospital to a Long-Term Care Hospital: 5 Post-Acute Service Episodes



Source: Lewin-VHI analysis of Medicare Part A claims.

acute service episodes (8 out of 13). About one-half of patients discharged to home health care after their first SNF service episode were rehospitalized during their subsequent three post-acute service episodes (8 out of 18). Most of the patients with a gap in service following their first SNF discharge also were rehospitalized during their subsequent three post-acute service episodes (10 out of 12). Less than one-half of the UCDSS sample patients discharged from the hospital to a SNF died before the end of the study period (32 out of 77). Interestingly, 24 of the 77 UCDSS sample patients discharged from the first hospitalization to a SNF were discharged back to SNF following either an acute rehospitalization or a gap before the end of the fourth post-acute service episode. Two UCDSS sample patients were discharged from their first SNF service episode and had no further Part A claims by the end of the study period.

The second most frequent first post-acute discharge destination for UCDSS sample patients was home health care (51 out of 247) (see Exhibit 7.19). Of these patients, about one-half who survived their first home health service episode were readmitted to an acute hospital (23 out of 49) and more than one-half of these patients who survived the rehospitalization returned to home health care (11 out of 23). Another pattern for UCDSS sample patients discharged from the hospital to home health care was a service gap following the first home health service episode (13 out of 49). This service gap was followed by either a rehospitalization (6 out of 13) or a readmission to home health care (6 out of 13). About one-fourth of the UCDSS sample patients discharged from the hospital to home health care died before the end of the study period (12 out of 51). Twelve patients were discharged from the hospital to home health care and had no further Part A claims by the end of the study period.

The third most frequent first post-acute discharge destination for UCDSS sample patients was a long-term hospital (39 out of 247). Of the 39 patients discharged from an acute hospital to a long-term care hospital one-third of the patients died in the long-term care hospital (n=13). Of the remaining 26 patients, nine were discharged to home health care, five to a SNF, four were readmitted to an acute hospital and four had a service gap. Interestingly, about one-half of the UCDSS sample patients discharged from an acute hospital to a long-term care hospital for their first post-acute service episode and who had a readmission to the hospital returned to a long-term care hospital after the rehospitalization (7 out of 15). Three patients also returned to a long-term care hospital after a service gap. More than one-half of the patients from the UCDSS sample discharged from the hospital to a long-term care hospital died before the end of the study period (21 out of 39). Three UCDSS sample patients were discharged to a long-term care hospital after their first hospitalization and had no further claims by the end of the study period.

Thirteen UCDSS sample patients started with an acute hospital service episode, were discharged alive from the hospital, and had no further Part A claims.

VI. DISCUSSION

This study has highlighted the complexity of post-acute patterns of care for chronic ventilator dependent patients. The literature tends to claim success because ventilator dependent patients are being discharged from the hospital. In fact the literature represents the post-acute service episode as a successful event that occurs in one setting. This study strongly suggests that these are not accurate perceptions. The majority of the ventilator dependent patients we studied, both from the four VDUs and from the large UCDSS sample, moved from setting to setting and had one or more readmissions to the hospital setting. This study suggests that we cannot declare success when a patient is discharged from the hospital setting to an alternative setting because that patient is likely to be readmitted to the hospital. Nor can we think of the care of chronic ventilator dependent patients as taking place in the hospital versus an alternative setting. This study suggests that even when patients are not readmitted to the hospital, they are served in multiple post-acute settings.

Home health care was the post-acute setting (or non-hospital setting) with the largest proportion of service days for all five patient populations. Patients from three of the four VDUs spent approximately one-fourth of the days covered by Part A claims in the study period with home health care. Patients in the UCDSS sample spent more than one-third of the days covered by Part A claims in the study period with home health care. We did not put a value on the time family caregivers devote to caring for ventilator dependent patients. This is not to say, however, that these costs should not be recognized. Although a relatively small proportion of the days covered by Part A claims in the study period were spent in other post-acute settings (i.e., SNFs, rehabilitation settings or long-term care hospitals), a number of patients were in and out of these types of facilities.

Policy makers and researchers have tended to examine post-acute care from either the perspective of savings generated by moving patients out of the hospital or from the providers perspective of financial incentives. Medicare reimbursement policies treat each type of setting as a discrete entity. This perspective seems to ignore the reality of the linkages between these settings. Intuitively we know that there are linkages between settings. Yet we know little about these linkages. It is apparent that we must focus on the linkages between settings to determine whether the patient's continuity of care is being well-served. The flow charts in Exhibits 7.14 through 7.20 illustrate that these patients bounce from setting to setting. Even if each of the post-acute settings offers something unique and valuable, it is not clear that transferring patients from setting to setting is beneficial for the patient.

The pattern of hospital readmissions for the patients studied raises concerns. Two-thirds of VDU patients discharged alive from the VDU had at least one rehospitalization and a substantial number of VDU patients had more than one rehospitalization. Almost one-half of the patients in the UCDSS sample who were discharged alive from their first hospital service

episode had a readmission to the hospital (47.4%). A number of patients in the UCDSS sample who had at least one hospital readmission had more than one readmission.

Medicare reimbursement policy for readmissions also may have an effect. Hospitals are paid the DRG rate for readmissions occurring more than 24 hours after hospital discharge as long as patients have not exhausted their hospital benefits. Apparently, when PPS was designed, HCFA had concerns about the financial incentives and the potential gaming of readmissions. HCFA instituted PRO review of readmissions occurring within 31 days of discharge to identify and deny inappropriate readmissions. More recently the PROs have not been required to explicitly review readmissions. Instead, a small random sample of all hospital discharges are reviewed by PROs. As a result there appears to be little explicit monitoring of readmissions. Obviously, the financial incentive is for hospitals to discharge patients to alternative settings whenever possible. While there is great pressure to discharge patients from the hospital as quickly as possible, there is little competing regulatory pressure to assure that patients who have marginal capacity to remain in a post-acute setting get the care they need in the hospital prior to discharge. The physicians who care for these patients are, of course, professionally and legally responsible for attesting to the patients' readiness for discharge. Hospital-based physicians, however, are under considerable pressure to discharge patients and may have little knowledge of the actual services provided patients in post-acute settings.

CMS Library
C2-07-13
7500 Security Blvd.
Baltimore, Maryland 21244

CMS LIBRARY
3 8095 00007192 4